

MILITARY OPERATIONS RESEARCH SOCIETY



*Advancing C4ISR Assessment
Workshop Report
31 October - 2 November 2000*

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Introduction

On 30 October – 2 November 2000, MORS conducted the latest in a series of workshops focusing military operations research on C4ISR issues, this one entitled *Advancing C4ISR Assessment*. RADM Robert Nutwell, Deputy Assistant Secretary of Defense for Command, Control, Communications, Intelligence Surveillance, Reconnaissance and Space Systems (C3I/C3ISR&SS) played the role of both Keynote Speaker and continuing champion of our efforts. The workshop was held at the Center for Strategic Leadership, Army War College, Carlisle Barracks, Pennsylvania. Dr. Cy Staniec of Logicon, Dr. Stuart Starr, FS of MITRE, and Mr. Charles Taylor of the Joint C4ISR Decision Support Center (DSC) were the technical co-chairs of the event. Ms. Sue Iwanski, of SPA, served as the MORS “Bulldog,” keeping timelines and products on track.

This report documents the activities and deliberations of the workshop. The report is organized first with this introduction that summarizes the workshop, followed by the reports of the working groups.

Workshop Goal. The goal of the C4ISR workshop was to help formulate a plan of action to address the deficiencies that currently restrict the analytical community from adequately assessing the impact of C4ISR systems and functions on military capability.

Approach. To accomplish, the goal the workshop was organized into five working groups based upon military operations, while a sixth served as a Synthesis Group. The five operations-oriented working groups were (1) Major Theater of War (MTW), (2) Coercion Operations, (3) Peace Operations/Humanitarian Assistance (PO/HA), (4) Urban Warfare, (5) Counter-Terrorism/Weapons of Mass Destruction (CT/WMD). (See Table 1 for a list of Chairs and Co-Chairs) The Synthesis Working Group monitored the work and discussions of the other groups and then integrated across their findings and recommendations to highlight important concepts and common themes. The working groups were presented with questions from a hypothetical senior Defense Department official, asked to formulate a plan to answer the questions using best methods and tools available, and then to critique their plan. The purpose of the exercise was to help pinpoint underlying weakness in existing C4ISR analytic methods and tools, and then to use the workshop environment to discuss the impact of these weaknesses and possible solutions.

<u>Working Group</u>	<u>Chair/Co-Chair</u>
MTW	Dr. Mark Youngren, MITRE/ Mr. Kurt Willstatter, Teledyne Brown
Coercion	Dr. Richard Hayes, EBR/ Col Dave Anhalt, OSD/USD(P)
Urban Operations	Mr. Warren Olson, IDA/Mr. Chris Christenson, IDA
Peace Operations, Humanitarian Assistance	Mr. Bob Holcomb, IDA/ Mr. Bob Smith, Raytheon
Counter Terrorism/ Weapons of Mass Destruction	Ms. Melissa Hathaway, BAH/Ms. Brena Starr, BAH
Synthesis	Dr. Stuart Starr, FS, MITRE

Table 1. Working Group Chairs and Co-Chairs

The Workshop Activities

Tutorials. In a modest break with past workshop activities, this year’s workshop sponsored a Tutorial Session on the Monday afternoon preceding the Plenary Session. Dr. Starr organized this effort into

two tracks, one focusing on Models and Simulations (M&S) the other on more non-traditional assessment methods.

Track I of the tutorials was moderated by Joe Jennings, MITRE. The track featured 5 presentations that employed M&S to assess C4ISR in diverse ways:

- *Explicit* representation of C4ISR effects in *constructive* simulations (JWARS, Pegasus);
- *Explicit* representation of C4ISR performance and interoperability in *engineering* simulations (Simulation Based Acquisition);
- *Stimulation* of real-world or prototype C4ISR systems and human actors by *virtual* simulations (Joint Semi-Automated Forces); and,
- *Implicit* representation of C4ISR effects in high-level analytic models (mission-system analysis of the halt problem).

Two common problems were observed across the presentations: the challenge in acquiring needed data and the treatment of uncertainty when the number of variables is too large for traditional sensitivity analysis. One potential way of dealing with these issues is to employ a multi-resolution *family* of M&S that is tailored to the specific analytical problem.

Professor Bill Kemple, Naval Postgraduate School, moderated track II of the tutorials. The track featured a broad set of C4ISR assessment techniques, many of which represented unorthodox approaches for the OR community. They included:

- A perspective on the tools and approaches cited in the NATO Code of Best Practices (COBP) for C2 Assessment;
- The use of Influence Diagrams and Bayesian Networks to examine probable effects of actions or events on targeted decision makers (SIAM);
- The collection, organization and application of cultural information to support psychological operations and coalition teamwork (Cultural Logic);
- The use of interactive functional decomposition diagrams to assess the impact of C4ISR system improvements at the mission level using a Quantitative Threshold Assessment at the task level; and,
- The application of the “New Sciences” to analyze warfare (Project Albert).

One insight from the presentations was that Effects Based Analysis might prove to be a useful template to cover all of the mission areas considered at the workshop.

In addition, Keith Dean, DSC, provided a tutorial that described the Joint Mission Area Analysis Tool (JMAAT) and the DSC’s three linked databases: M&S, Studies and Points of Contact.

Plenary Session. The Plenary Session Tuesday morning helped to focus workshop participants with three presentations.

Keynote Address by RADM Nutwell. RADM Nutwell began the Plenary Session by declaring that our purpose was to “Move the Art and Science of C4ISR Analysis Forward.” He then addressed what he believed to be the purposes of analysis:

- Support for acquisition (characterized by engineering level detail);
- Support for investment decisions (characterized by concern for broad trades within investment areas);
- Combat decision aids (e.g., Target Weapon Pairing); and,

- Training aids (e.g., Joint Simulation System).

He stated that the workshop task was directed towards C4ISR analysis that related to support for investment decisions and that we should focus on how to improve our tools and methodological constructs to provide support. He offered that the workshop could do that in a number of ways:

- Acting as a clearing house for information and ideas;
- Providing education; and,
- Identifying, coordinating, focusing efforts for the future.

RADM Nutwell then proceeded to remind us of where we had left off at our last gathering and charged us to push further in the areas of:

- Lack of data;
- Quality Measures of Merit (MoM); and,
- A Code of Best Practices.

"The C4ISR M&S Master Plan" by Mr. Keith Dean. Mr. Keith Dean of OASD (C3I)/DSC presented an information briefing on the C4ISR M&S Master Plan. The plan is being created with the goal of improving the C4ISR component of the DoD's M&S capability. The DSC is developing the plan with a focus on the value of information superiority in warfighting. The next step will be to coordinate the plan with the other elements of the OSD staff, the Joint Staff and other Agencies to ensure consistency with existing plans.

"Recent Advances" by Dr. Stuart Starr, FS. Dr. Starr presented a briefing on "Recent Advances in C4ISR Assessment." He discussed findings from the MORS workshop on C4ISR Analysis for 2010 (ref. 1) and the NATO COBP for C2 Assessment (ref. 2) that provide background for the recent advances in C4ISR Assessment.

When discussing the recent advances, Dr. Starr addressed the emerging insights on cultural changes, C4ISR Policy, Measures of Merit (MoM), along with emerging tools such as M&S, effects-based assessment, and dealing with complex, poorly defined problems. Some of Dr. Starr's final observations include:

- C4ISR assessments inherently address complex, poorly defined problems;
- The C4ISR assessment process is generally not a linear process that is reducible to a "cook book"; and,
- A plan of action is needed for stimulating the creativity of the C4ISR assessment community while reinforcing the need for RIGOR (i.e. Repeatability, Independence, Grounding in reality, Objectivity of process and Robustness of results).

Lunch Time Presentations. Three luncheon speakers provided their insights to the workshop participants.

"Air War over Serbia: Analysis of Lessons Learned" by Col Negron. Col Jose Negron of the Air Force Studies and Analyses Agency provided a briefing on the analysis of the lessons learned from the air war over Serbia. A key observation was that while the community invariably asks for investigations into what happened, it rarely plans for such activities in terms of either the personnel or data gathering required to accurately assess performance.

"Searching for a Unified Theory of Warfare" by Mark Herman. On Wednesday, Mark Herman, Booz-Allen & Hamilton, discussed his "Unified Theory of Warfare" and its implications to military analyses. He maintained that warfare is fundamentally unchanged since the beginning of time, and only technology and organizational concepts have evolved. He also advocated changing the analysis paradigm to measure the value of information and other key factors which, in turn, should be applied to future analyses of force effectiveness.

"Gettysburg, A Strategic and Operational Perspective" by Professor Fullenkamp. On the final day of the workshop, Professor Len Fullenkamp, Army War College, presented a strategic and operational perspective of the Battle of Gettysburg. His focus on Civil War C4ISR made it very clear that today's challenges are not new.

Major Findings and Conclusions

Findings. The aggregate findings from the workshop can be separated into four categories: education and training, data, models and tools, and a broad category encompassing what we have termed Military Art & Science.

- **Education and Training.** Efforts are needed to educate and train the analyst in realms beyond the traditional methods of attrition warfare and in the details of C4ISR "system space." Institution of a COBP within the analytic community is needed. This COBP should be acknowledged and reinforced within our customer base.
- **Data.** Data are of the utmost importance. All Working Groups were concerned with some facet of the "data issue" (e.g., the existence of data, the availability of existing data, the means by which data are verified, validated and certified). As Walter LaBerge once observed, "Without data we are nothing!" (ref. 3)
- **Tools.** No one model will ever be sufficient to address the breadth of all C4ISR issues. The community will need a flexible spectrum of carefully orchestrated tools.
 - **Military Art & Science**
 - **MoMs.** We need to understand non-attrition based, or "Effects Based," metrics and how to use them effectively in analysis
 - **Concepts.** "C4ISR" is not a single word. It includes processes (e.g., command, intelligence), functions (e.g., control) and systems (e.g., communications and computers).
 - **Problem Decomposition.** It was useful to decompose the mission space into the "New World Disorder Missions" (e.g., Coercion, Peace Operations (PO), Counter Terrorism (CT), and Urban Warfare). However, it must be recognized that all of these missions can occur simultaneously. An example of this is the contemporary events in the Middle East.
 - **Relative Maturity.** There is an enormous disparity in the relative maturity of our ability to do "C4ISR" analyses within the context of the 5 operations types. This maturity ranges, from highest to lowest, as follows:
 - MTW
 - PO, Humanitarian Relief
 - Urban Warfare
 - Coercion
 - CT/WMD

More specific findings in these four categories are summarized, by working group, in Table 2.

Table 2: Working Group Findings

Working Group	Education & Training	Data	Models and Tools	Military Art and Science
MTW	<ul style="list-style-type: none"> • Provide training in models for C4ISR analysis and new techniques • Need source of new young analysts and method of retaining old analyst experience 	<p>Needs:</p> <ul style="list-style-type: none"> • Collection management rules and priorities • Critical Information Requirements • C2 and Intel Timelines • Cost Data • Cueing and Fusion 	<p>Needs:</p> <ul style="list-style-type: none"> • Data Management and Visualization Tools • Post-processing • Scenario Development tools 	<p>Need to understand:</p> <ul style="list-style-type: none"> • Effects on non-combat items • Decision making • Relation of information volume to command support • Maneuver effects
Coercion	<ul style="list-style-type: none"> • Encourage explicit training in schools – include lessons learned • Incorporate social scientists and their methods • Need training for commanders and key staff 	<ul style="list-style-type: none"> • Develop tools for transforming “soft” knowledge into data 	<ul style="list-style-type: none"> • Need to develop tools for adaptive systems • Need to develop “compliance” MOEs 	<ul style="list-style-type: none"> • Create robust architecture for rapid decisive operations • Need understanding of Red responses
Urban Operations	<ul style="list-style-type: none"> • Training is required in urban C4ISR issues, urban geo-spatial systems and data 	<ul style="list-style-type: none"> • Need better Urban terrain, features, cultural and demographic data • Generally need data collection, assessment and dissemination 	<ul style="list-style-type: none"> • Need algorithms that address action/reaction/interaction • Need enhanced models and tools 	<ul style="list-style-type: none"> • Need to understand relationships that “translate” MOPs in MOEs
Peace Ops and Humanitarian Assistance	<ul style="list-style-type: none"> • Educate analysts in non-combat analysis of non-combat missions – such as history, culture and other mission objectives (measures of success) • Focus on Joint, combined, multi-discipline, multi-organizational approaches 	<ul style="list-style-type: none"> • Improve general practices in data collection and management, interoperability and availability 	<ul style="list-style-type: none"> • Tools are woefully short, but experimentation and gaming offer opportunity • Most existing models deemed not generally applicable – new starts necessary 	<ul style="list-style-type: none"> • Get multidisciplinary analysis teams into the JTFs and into the field, including for exercise and training
Counter-Terrorism / Counter-WMD	<ul style="list-style-type: none"> • General need to provide training in this area 	<ul style="list-style-type: none"> • Need to address the problem of too many stakeholders – too much “righteous” data (need for data fusion and interoperability) • Need to improve access to data 	<ul style="list-style-type: none"> • Need a clear framework for analysis – including Business Process Models, Human Factors, etc • Need tools like Complex Adaptive Systems models 	<p>Need to understand:</p> <ul style="list-style-type: none"> • Blue CONOPs and capabilities • Support role of C4ISR • Human Stress Behaviors

Conclusions. There are several key elements to a plan of action that could ameliorate identified deficiencies. These are addressed under the headings: culture, people, policies, data, tools, R&D and products.

- **Culture.** Initiate actions (e.g., meetings, coordination efforts and socialization) to breakdown barriers among the diverse communities who must participate in C4ISR assessments in selected mission areas. These communities may include other disciplines (e.g., social scientists) as well as other organizations (e.g., FEMA, Non-Governmental Organizations (NGO)).
- **People.** Develop curricula and programs to enhance education and training for analysts to deal with new missions, methodologies, and tools.
- **Policies.** Reassess existing policies that severely restrict the flow of data across institutional barriers to *rebalance* security concerns and the need to know.
- **Data.** Develop a comprehensive community-wide program to provide the verified, validated and certified data needed to support C4ISR assessment. The community also needs to work with various organizations such as the Joint Staff, J8, OSD(C3I), and MORS to develop standard ontologies for key domains (e.g., military C4ISR, Ops Analysis) that are consistent with the emerging IEEE Standard Upper Ontology.
- **Tools.** Convene a workshop to address and compare attrition versus effects-based assessment. MORS is planning for a special meeting on this topic to be held in early 2002.
- **R&D.** Develop a comprehensive DoD-wide program to perform research into "soft factors", (e.g., how reason and belief affect operational effectiveness) and the effects of attacks on command personnel, facilities, and on C4ISR resources.
- **Products.** Conduct a Middle East case study to begin to understand the C4ISR implications of a mix of complex missions such as Coercion, Counter-Terrorism (CT), Urban Operations, and Peace Operations (PO). In addition, MORS should devote a special issue of *Military Operations Research* to the application of the NATO COBP for C2 Assessment to selected case studies to encourage the use of the COBP.

Closing Comments. This workshop provided value to the community in several ways. First, the NATO COBP for C2 Assessment was put forward as a framework for C4ISR Analyses. Second, for the types of operations where our ability to do C4ISR analysis is less mature, the workshop served to identify issues that we need to focus on. Finally, the workshop served to identify major shortfalls that limit the community's ability to perform C4ISR assessments in a mission context. The most significant of these shortfalls are the education and training of our analysts, the absence of vital data and deficiencies in our tools (particularly in their treatment of reasoning and belief of the actors). These issues must be addressed if the community is ever to develop the ability to adequately assess the role of C4ISR in military missions, its impact on outcome, and the degree to which it should be considered when planning force structure. Failure to address these issues will ensure continued use of anachronistic methods that in turn can only lead to anachronistic system responses.

A set of observations about these shortfalls and potential ways to address them has been provided to the Joint C4ISR Decision Support Center. Their intent is to build on these inputs and to issue a Plan of Action and Milestones (POA&M) to address them. This plan is in progress, and has been briefed to RADM Nutwell. It will be shared with the MORS Sponsors as soon as practical. Major themes of the POA&M will be Education, Data, and Research into Analytic Methods. Several other actions have been initiated as outgrowths of the Workshop. Ms. Iwanski has taken the lead in ensuring that the Effects

Based Analysis Special Meeting integrates our findings and the education colloquium held in April 2001 included discussion of the NATO COBP for C2 Assessment.

Individual Working Group Findings.

Major Theater of War (MTW) Panel (pg 9). The MTW panel found that analyzing C4ISR Analysis support to the MTW mission would benefit from investments made in:

- Increasing the number of analysts, with emphasis on education and training of junior analysts;
- Establishing rules and priorities in collection management and critical information requirements for standard scenarios;
- Analyzing the effect of attacks, degradation or disruption on non-combat items, maneuver effects and the relationship between information volume and support to the commander;
- Developing analytic support aids such as data management and visualization tools, post-processing tools and scenario development tools; and,
- Improving existing tools for C2 and behavior, perception, IO and the level of effort in C4ISR relative to weapons.

Coercion Panel (pg 41). The Coercion panel found that deficiencies in analyzing C4ISR analysts in Coercion Operations could be ameliorated by:

- Creation of a communication architecture to receive the information relevant to compliance indicators as well as communicating the right signals and warnings to the belligerent parties;
- Investment in tools to transform "soft" data and information into operations quality data; and,
- Training and new perspectives of Commanders and staff on the theory of conventional deterrence for coercive operations, transparent battle management tools, and multi-sided situations.

Urban Operations Panel (pg 81). The Urban Operations panel found that investments in the analytic infrastructure in their area should focus on:

- Training analysts in urban and C4ISR issues, cutting-edge geo-spatial and urban database development tools and techniques;
- Development and acceptance of M&S;
- Instrumentation, data collection, assessment and dissemination; and,
- Pursuit of metrics and assessments of the approach for translating C4ISR measures of performance into force effectiveness measures of effectiveness.

Peace Operations/Humanitarian Assistance (PO/HA) Panel (pg 99). The PO/HA panel recommended five areas of improvement in analytical infrastructure.

- Educate analysts on how PO/HA mission differs from conflict-based analysis, the local context (history and culture) of the mission, and the differences among stakeholders such as in culture, terminology and goals;
- Change our analytic skill sets to emphasize Joint and Combined experience, multidisciplinary focuses (social and behavioral science), and multi-organizational experiences (e.g., UN, World Bank, State Department);
- Improve data access, collection and management using data management techniques and knowledge management practices with a focus on the interoperability of data collection, processing, and distribution, and data integrity and validity;

- Develop tools and models through gaming, actual operations, and live exercises; and,
- Conduct operations analysis during operations by establishing an analysis team on staff during the crisis that would have multi-disciplinary and multi-organizational backgrounds. This team would later form the basis of the lessons learned team.

Counter Terrorism/Weapons of Mass Destruction (CT/WMD) Panel (pg 127). The CT/WMD panel found that deficiencies in C4ISR analysis in their area could be ameliorated by:

- Increasing exercises that involve all stakeholders;
- Developing data warehousing and smart agents to increase the flow of information to all levels;
- Developing models to understand information flow to create the framework to understanding the adversary, and to establish criteria to predict the event;
- Investigating applicability of Complex Adaptive Systems (CAS);
- Conducting research to evaluate existing studies, models, data and theories;
- Identifying existing or developing new Memoranda of Agreement (MOA) with other agencies to obtain necessary data and to understand the requirements under the Federal Reserve Plan; and,
- Conducting requirements analyses as part of future assessments.

Synthesis Panel (pg 161).

References:

1. ***"MORS Workshop on Analyzing C4ISR in 2010,"*** Russell Richards, *PHALANX*; Vol. 32, No.2, page 10, June 1999
2. ***"Code of Best Practice (COBP) on the Assessment of C2,"*** RTG Technical Report-9 AC/323 (SAS)TP/4, Neuilly-Sur-Seine Codex, France March 1999 [note: accessible at <http://www.dodccrp.org>]
3. ***"Simulation Technology 1997 (SIMTECH 1997),"*** Proceedings of Session II, Monterey CA, 12 October 1988



**Working Group Report
WG 1 – Major Theater Warfare (MTW)**

Mark Youngren
Kurt Willstatter



A Way to Approach the Problem

- How we can accomplish a C4ISR-centric analysis today?
 - What is our approach today?
 - What pieces of the analysis is as good as it needs to be?
 - How good *does* it need to be?
 - What could we do better? What are the constraints?
 - Understanding the process
 - Data
 - Time and resources
 - ...
 - What would we recommend to make it better?
- What would the ideal C4ISR-centric analysis look like?



The Analysis Process **(Per NATO Code of Best Practice)**

- Understanding the problem/analysis questions(s)
- Analysis approach - How do I answer the question?
 - Human factors and organizational issues (political constraints as well as issues within the analysis)
 - Basic approach - study of studies, analytic approach, wargaming, simulation, etc.
 - How good is good enough?
- Scenario
- Measures of Merit (MoM)
- Tools
 - Data
- Risk and uncertainty
- Report (documentation)



MTW Working Group Issue

- What are the possible trade-offs between Strike weapons/platforms/maneuver forces and investment in C4ISR?
 - Restate as: Given a fixed total budget, how do we allocate between C4ISR and weapons?
 - What is allowable within the trade space?
 - Fixed, finite set of trades
 - What can we analyze (and what can't we analyze) with respect to specific C4ISR capabilities - not homogenous

The focus question provides an example of a typical C4ISR related tradeoff that decision makers ask. It can be restated to clarify as a budget issue such as that asked during a QDR.



Broad Mission Objective

- In the event of a Major Theater War (MTW) the United States' objective in entering conflict will be:
 - Restore territorial status ante bellum
 - Retain regional stability
 - Minimize friendly, neutral and enemy casualties
 - Force attrition may be required
 - Regime removal possible
 - Diplomatic and economic issues
 - Achieve within a timeframe



Assumptions

- We will have to make the following major assumptions to frame the analysis:
 - 6-12 months to answer the question
 - Resources: "average"
 - Classification level - collateral
 - Result briefed as a "budget" issue



Measures of Merit

- In the conduct of this mission the means by which we measure ultimate success is:
 - Measures of Force Effectiveness (MoFE) (hard)
 - Measures of policy effectiveness (even harder)
- Secondary measures which provide insight into our ability to conduct this mission at the macro level are:
 - Measures of Effectiveness (MoE)
 - Both C4ISR and weapons effectiveness needed
 - Not sufficient even in combination

Measures of Force Effectiveness (MoFE):

Time to achieve objectives
Timeliness of maneuver (vs. planned)
Casualties

Measures of Effectiveness:

(%) of red units known
Accuracy of known units (location, velocity, etc.)
Timeliness
Strength knowledge (BDA)
Identification accuracy
of munitions per kill
Strikes/sorties
Times when phases change
When intent discerned (accuracy as well)
of ambiguities (including neutrals)
of targets cued (for strike, ISR, other)
of dynamic taskings
of correct/incorrect correlations and associations
Batch between static collection plan and actual enemy locations, etc.
Match between static collection plan and actual enemy location



Measures of Merit Other ideas and concerns

- Constructed measures
 - I&W accuracy
 - Situation awareness
- Issues:
 - JV2020 objectives not equal to MoFE's
 - For MoFE, we don't have an understanding of how we achieve them (e.g., coerce leader)
 - Don't understand effects of targeting many things (to include attacks on us)
 - Collateral effects (e.g., world or US public opinion) not well understood - centers of gravity other than military
 - Maneuver effects (other than direct fire) not well understood



Impact of C4ISR on Mission Success

- Our hypothesis is that information has the following cause and effect relationships with mission success:
 - Hypothesis: C4ISR can improve weapon performance
 - Hypothesis: C4ISR can reduce need for weapons by precluding their use



Analytic Method Human and Organizational Factors

- Human and organizational factors within the analysis (see tools and data slides)
- Human and organizational factors within which the analysis is done
 - Stakeholder analysis
 - Brief out
 - How do we get peer review early?

Peer review ideas:

Subject Matter Experts (SMEs)
Right people
Methodology vs. answers
Use DSC studies database for "experts"
Stakeholder
Analysts



Analytic Method

- What possible approaches are currently available for answering the question?
 - Depends on MoM, scenario and specific trade space
 - Study of Studies
 - BOGSAT
 - Wargaming
 - Man In The Loop (MITL) models
 - Constructive simulations
 - Analytic models



Analytic Method - Tools

- Constructive simulation (necessary but not sufficient)
 - May depend on number of alternatives and number of independent variables
 - Total time also an issue (warfighting time vs. clock time)
 - Data, alternative scenarios, etc. may limit use
 - Usefulness may be less when uncertain about many things (e.g., for future)
 - May be required, if enough time is available



Analytic Method - Tools

- Wargaming
 - Helps ID hypotheses
 - ID that doctrine changes are possible
 - Experimental data on human behavior
 - May help customer buy-in (education of customer)
- Expert elicitation (BOGSAT)
 - OK for inputs
 - Only OK for answering analysis if very time-limited
- Analytical (simple) models - precise answer to the approximate problem
 - Good for limited domains
 - Helps get insights
 - Large scale screening



Analytic Methods Tradeoffs

- Transparency vs. Complexity
- Abstraction vs. detail
- Abstraction vs. accuracy

Are any of our models useful without better data?



Scenario

What does it do for us?

Force structures

Initial conditions

Red and Blue O-Plans

Stress different systems

How does it limit us?

Political limitations (e.g.,
acceptable outcomes)

One operational plan (Red and
Blue)

Fixed deployment, mob
schedules



Scenario/ Data Experimental Design

Fixed

- Force Structure (red)
- Force structure (blue) - except for tradeoffs
- TPFDD?
- Operational objectives
- Non-enemy constraints

Independent Variables

- C4ISR and weapon trades
- Operational plans (Red) Blue?
- Use of ISR assets
- ROE
- TPFDD?
- Doctrine/CONOPS
- Weather
 - What flies
 - ISR success
 - Tactics and combat effects
 - Mobility



Scenario Issues

- Pre D-Day I&W
- Tactical vs. Operational behavior (e.g., air defense)
- 2 MTW timing
- Not enough detail to form a common baseline
 - Standardized formats
- Time, resources, DIA support for alternative scenarios
- Who develops and approves alternative doctrine, OPLANS, CONOPS and tactical objectives



What is Data?

- System performance
- Scenario - signature attributes
- Tactics (Red, Blue), CONOPS, doctrine, OPLANS, COAs
- Behaviors
- Comms
- ISR
- IO/IW
- Cost data!!
- Info on commercial systems (comms/imagery)
- Environment - Refugees/collateral clutter/imitations

System performance

OK except for: human performance, future data

Scenario - signature attributes

Static - poor

Dynamic - ~non-existent

Requirements not approved/standardized

CINF - Imagery only/fixed scenario

SIGINT - little

Comms data - how often??

TPED quantitative data

Exploitation accuracy

Type I errors

Type II errors

COMINT - internals (models and data)

SIGINT externals (data)

IO, IW - lack models and data - definition!!

Collection management - priorities, etc.

Behavior

Decision rules (esp Red, esp. non-Soviet)

times (processing, etc.)

Errors

Cultural effects

Morale, training, etc.



Data Issues

- Who can (should) validate?
- When is it believable? (bias)
- Classification
- Models that link engineering data to system performance in combat for ISR and C2
 - Funding
 - Structure (process)
- Priority weights (for MAUA)
- Peacetime/national/other commitments outside of MTW



Areas that need work understanding/models

- Effect of attacking non-combat systems or non-lethal attacks
- Decision making and planning under uncertainty
 - Management and "optimization" of multiple systems (and multi-role systems)
 - Effect of coordination, synergy, combined arms, etc.
- Relationship between information volume & support to the commander
- Effect of maneuver on combat outcomes
- Behavior
- Effect of partial losses and degradation or unit/system as a whole
- Quantifying decision aids/IT
- Fusion
- Deception

Effect of maneuver on combat outcomes

surprise

flank vs. head-on attack

Quantifying

decision aids

video (both ISR and C2)



Risk and Uncertainty

- Not enough excursions (analyst framework)
 - Data, political factors, time
- Risk and uncertainty in decision making not considered (within analysis)
- Risks to HD/LD not modeled
- Fail to report distributions for things that vary
 - Lack of senior support - risk communication
 - Peer review
 - Risk avoidance vs. better warfighting
- QDR requirement!
- Worst case analysis (how bad, how likely)?
- Data uncertainty -> output uncertainty, even if model perfect

?Worst case analysis (how bad, how likely)?

Near peer, WMD asymmetric



Risk and Uncertainty What helps?

- Exploratory analysis - excursions, etc.
- More post-processing of output data (more than using "average")
- Supercomputers - more trouble than they are worth
- Data!
- Competing or Complimentary models (informal federations)
- Advancing state of the science (understanding)
- Investigate and Report on parameter uncertainty and dependencies

Risk \neq Uncertainty
Uncertainty \neq Variability



Investments in Analytic Infrastructure

- Based on our identified shortcomings we recommend the following investments in the analytic infrastructure:
 - Analysts
 - Data
 - Military art and science (relatively cheap)
 - Analyst support aids
 - Improvements to existing tools



Analysts

- Education and training
 - Use of models for C4ISR analyses
 - New techniques
 - Money for civilians (and contractors?) to attend military schooling
 - Needs to be junior to be effective
 - Distance learning
 - Participate in exercises (observe) and wargames
- Numbers (consequence of outsourcing)
 - ORSA intern GS starting level too low (GS-5)
 - Hiring - hard, competitive; graying of force
 - Hard to grow your own
 - Hard to get clearances
 - Knowledge elicitation from retiring "experts"
- Access to key decision makers early in the process and to develop models



Data

- Rules and priorities for collection management
- Critical information requirements for standard scenario
- C2 and intelligence timelines
- Cost data
- Cross-INT cueing and fusion

Process for data creation, storage and update
Security: SCI/SAP -> Collateral



Military Art and Science

■ Key areas

- Effect of attacks, degradation or disruption on non-combat items
- Decision making
- Relationship between information volume and support to the commander
- Maneuver effects



Analyst Support Aids

- Data management and visualization tools
- Post-processing tools
- Scenario development tools

Most time spent getting data



Existing Tool Improvements

- C2 and behavior
- Perception
- IO and IW
- Level of Effort in C4ISR relative to weapons



C4ISR Analysis vs. Weapon Analysis

- C2 - behavior
- ISR .ne. Averages
- SR - I involves humans
- C4ISR always on vs. short combat periods
- More reliance on C4ISR success
- Comms is not an easy/solution
 - Volume vs. information
 - actual loadings as a function of warfight
 - hard to aggregate ("ATCAL for comms")
 - C2 dictates many comms requirements



Workshop Findings

- We believe the following deficiencies to be the greatest hindrance to quality analysis of C4ISR issues:
 - 1. Clear data requirements
 - 2. Authoritative data sources that are mandated and funded to provide periodic data delivery as part of an integrated process to provide planned, programmed and hypothetical data with broad releasability for most data and well defined release procedures for sensitive data



Impact of Improvements

- Without these steps C4ISR analyses will continue to suffer from the following ailments:
 - Limited ability to vary CONOPS
 - Especially not reactive to
 - Changes in C4ISR, weapons (trade space)
 - Previous combat outcomes during campaign (learning)
 - No change with time, fatigue, attrition
 - Ability to automate decisions
 - Scripting
 - Simple (possibly stupid) rules
 - Human thinking
 - Static or scripted scenarios/inputs (e.g., CINF)
 - Maneuver models
 - Timing (in aggregate models)
 - Perception handling
 - TPFDD - model link



**Working Group Report
WG 2 - Coercion**

**Richard Hayes
Dave Anhalt**



Coercion WG Members

■ Dr Richard E. Hayes, Co-Chair	EBR, inc
■ Col David Anhalt, Co-Chair	OSD Net Assessment
■ MAJ Chris Bailey	USSOCOM-SORR-SC
■ LCDR Pat Curtin	OPNAV N81 ISS IWAR
■ Dr Elizabeth D'Andrea	JWAC
■ Capt Michael Faris	HQ AFOTEC/TSE
■ Capt Roger Gallan	HQ AFOTEC/TSE (C4I)
■ Joe Jennings	Mitre/Joint Experimentation
■ LTC Moses Kamai	OASD (SO/LIC) SOP&S
■ Hans Keithley	OSD/C3I/Decision Support Center

The Coercion Working Group was made up of a variety of very talented professionals who worked hard throughout the workshop. They proved to be a broad, deep, experienced and talented group. Working together well, showing mutual respect, but never hesitating to offer thoughtful comments and criticisms. As a result, they were able to penetrate the problem of C4ISR in coercive operations.

The Working Group Chair and Co-Chair want to thank all the members of the group for their efforts. RADM (ret) Gary Wheatley and Mr John Ray deserve special thanks for their work in preparing for the workshop and handling administrative details for the working group



Coercion WG Members (cont'd)

■ Dan McConnell	MITRE
■ CPT John Overend	Center for Army Analysis
■ Tom Pawlowski	MITRE
■ Jack Ray	EBR, inc.
■ Steve Topper	Teledyne Brown Engineering
■ LTC James Treharne	TRADOC analysis center
■ Bill Waddell	Army War College
■ RADM Gary Wheatley (Ret.)	EBR, inc.
■ Greg Whittaker	MITRE
■ Dr Larry Wiener	OPNAV N6C

The main body of the report provides details of the discussion within the working group and the logic behind the recommendations.



WG 2 - Coercion

Executive Summary



Problem Statement: Coercive Operations

- **Impose US will**
 - Synchronized application of the elements of national power
 - To impact the attitudes, perceptions, and behaviors
 - Of key foreign leaders, organizations, and populations
 - To achieve specified national objectives
- **Graduated options that require**
 - Systematic, in-depth contingency plans
 - Credible commitment to escalate from persuasion to threats, demonstrations of capability, disabling adversaries, defeating forces and punishing non-compliance

Coercive operations are efforts to impose the US will through the synchronized application of the elements of national power to impact behaviors of key foreign leaders, organizations, and populations. The working group concluded that this requires the systematic application of a set of graduated options that are best structured as in-depth contingency plans. The generic "ladder" of this structure runs from persuasion to threats, credible demonstrations of capability, actions that disable adversaries, defeat of adversary forces, and punishing non-compliance.



How to Address the Problem: Coercive Operations

- Early knowledge preparation of the battlespace
- Improved breadth and depth of linkage across key communities:
 - Collection
 - Analysis
 - Planning
 - Execution

To improve success in coercive operations, four general classes of things must change. First, the US must engage in early knowledge preparation of the battlespace. Second, linkages must be created among all the key communities: collection, analysis, planning and execution.



How to Address the Problem: Coercive Operations (cont'd)

- Invest in tools and talent to support rigorous analysis of behavioral issues: Impact on adversary will
 - Expand and validate behavioral data bases
 - Invest in development of analytic tools and behavioral models
 - Develop and validate robust systems of compliance indicators
 - Recruit more social scientists with operations research training
 - Train more traditional operations research analysts in behavioral science

Third, we lack the tools and talent to conduct rigorous analysis of the behavioral aspects of coercive operation. To improve performance in this area, we must expand and validate the behavioral data bases needed. We must also invest more in the relevant analytic tools and behavioral models needed. Further, the analytical community needs to develop and validate robust systems of compliance indicators. We also need to broaden the relevant talent pool.



How to Address the Problem: Coercive Operations (cont'd)

- Employ the full range of means available and the synchronization of activities
 - Provide leadership (commanders and key staff) more training and perspective on the concepts of influence, deterrence and coercive operations
 - Expand and exercise Public Affairs, Media Operations, Psychological Operations, Information Operations, Economic Operations and Diplomatic activity as a part of Coercive Operations
 - Expand linkages to non-DoD agencies needed to bring all the instruments of national power to bear cohesively

Our commanders and forces must be prepared to employ the full range of means available in coercive operations and synchronize that full range of activities. This means that commanders and staffs need more education on concepts such as influence, deterrence and coercion. The range of means exercised in depth must include media operations, psychological operations, information operations, economic operations and diplomatic activity. Both in exercises and the real world, linkages to other US government agencies and other relevant actors need to be enriched.



Good and Bad: Coercive Operations

■ Good

- Defines a transformation path
- Broad applicability
- Focuses on the real issues
- Development steps can be modular

■ Bad

- Substantial investments required
- Cultural barriers will be real
- Solutions require time
- Cultural barriers will be real

- Military-civilian
- Inter-service
- Inter-agency
- Coalition

This approach has clear strengths. It defines a clear path toward transformation. It also has broad application to a wide range of specific missions. It focuses attention on real issues. Further, it can be implemented modularly — the pieces interact and strengthen one another, but each makes an independent contribution. However, the recommended approach also faces impediments. Substantial (but not massive) investments will be required. Finally, because this approach moves away from simple applications of military instruments, it will encounter cultural barriers — military-civilian, inter-service, inter-agency and coalition; there is no immediate solution.



Recommendations: Coercion

- Find “champions” such as ASD/C3I, SOCOM, JFCOM or the JWAC to provide more visibility and represent coercion operations in the CIWG
- Invest in further development of:
 - Behavioral data bases and standard data structures
 - Tools and models to provide early warning of the need for coercive operations
 - Tools and models for the analysis of coercive operations and collaborative planning in them
 - Knowledge preparation of the battlespace for potential trouble spots
 - Development and validation of compliance indicators

“Champions” such as ASD /C3I, SOCOM, JFCOM or the JWAC need to be found in order to provide more visibility and represent coercion operations in the CIWG.

Five specific types of investment are recommended. The modest and largely ad hoc efforts currently being made in this area need to be expanded and coordinated. These include developing accessible behavioral databases and standard data structures. Furthermore, the development of tools and models needed to provide early warning for coercive operations must be accelerated, along with tools and models to support the analysis and planning of coercive operations. Moreover, once potential trouble spots are identified, early knowledge preparation of the battlespace should be undertaken. Investments are also needed in developing and validating compliance indicators.



Recommendations: Coercion (cont'd)

- Create and implement a robust and flexible architecture that can support rapid decisive operations
 - Across collection, analysis, planning and execution communities
 - Inter-agency
 - To include capability to work with coalition partners, NGOs, PVOs and international organizations
 - Establish tools for collaborative planning and synchronization of activities
 - Ensure capability to communicate with adversaries

A robust and flexible architecture supporting this type of rapid, decisive operation must be created. This means systems for sharing data, information, tools, and models across the collection, analysis, planning and execution communities. It also means an architecture that allows collaborative planning and action synchronization across US Government Agencies, coalition partners, NGOs, PVOs and international organizations. Coercive operations also require the capacity to communicate with adversaries.



Recommendations: Coercion (cont'd)

- Encourage military schools to incorporate coercive operations explicitly
 - Capture and promulgate lessons learned
 - Encourage faculty and student research on the topic
 - Teach the full range of national means available
 - Develop materials that focus on graduated options (including escalation and de-escalation) and effective contingency planning
- Expand the relevant base of expertise
 - Explicitly recruit social scientists (Ph.D. and Master's level with formal skills (OR, statistics, formal modeling) within DoD
 - Educate traditional military OR analysts in the relevant tools, models and literatures of formal social science

A broader education of US commanders and key staffs is needed. Military schools should be encouraged to develop materials that capture lessons learned from coercive operations and have student research focus on them. Curriculum should emphasize the full range of national means available and focus on the creation of graduated options and effective contingency planning.

Finally, we need to expand the base of expertise available, both by recruiting more formally trained social scientists and by providing education and training in social science methods and tools to the traditional operations research community



WG 2 - Coercion

Final Report



Suggested Definition of Coercion

- Coercion activities are the synchronized and coordinated application of the elements of national power, both non-lethal and lethal, in order to influence the attitudes, perceptions and behaviors of key leaders and individuals, national political, military and other organizations and population sets in order to achieve specified objectives.

Suggested Definition

The working group noted that there is no formal joint definition of coercion operations. This one was developed to fill the vacuum. The bulk of it is derived from general terms used to describe operations. The key differences are the goals – *in order to influence the attitudes, perceptions and behaviors* – and the targets – *key leaders and individuals, national, political and other political, military and other organizations and population sets*.

The working group also noted that all warfare is inherently coercive. That is, war is an effort to impose one nation state's will on another actor (nation, state or population). However, coercive operations are generally undertaken in an effort to avoid all out war or limit the level of violence needed.



Scenarios

- Ten scenarios used to analyze the issue:
 - Bosnia Muslim/Bosnia Kosovo (Europe)
 - Yemen/Iraq (Middle East)
 - Guatemala/Peru (Central and South America)
 - Sierra Leone/Rwanda (Sub-Saharan Africa)
 - East Timor/Fiji (Far East)
- Cases considered tended to have common attributes
 - Conventional deterrence mechanisms
 - Multi-sided conflicts
 - US not a primary belligerent

Members of the working group were given one of ten specific scenarios for review and analysis. All these scenarios followed the same general story line, which was also provided to the working group. It read *"The year is 2010. In each of the countries listed below, there are deep divisions along ethnic, political or religious differences. Each country has an authoritarian government that depends on support from one segment of the population (e.g. a particular clan, ethnic or religious group.) Each government has a history of human rights abuses and discrimination against less powerful population segments. Recently, those abuses have escalated and include torture and overt destruction in the dissidents' homeland areas. The victim populations have responded at two levels. First, the more moderate have started a political campaign for governmental reform, human rights and democracy. Others have started a violent resistance movement. The government has responded with brutal force and is deploying troops and organized thugs to displace the protesters and destroy their homes. The situation is critical and poses a major threat to the survival of the dissident population. Little time remains for effective intervention. Intelligence indicates that large scale, brutal repression, including "ethnic cleansing" is likely within days."*

Cases were chosen from around the world to avoid solutions based on the specific geography and basing of an individual situation. The selected cases were:

- Europe: Bosnia (Muslim context) and Bosnia (Kosovo),
- Latin America: Guatemala and Peru,
- Africa: Sierra Leone and Rwanda,
- Middle East: Iraq and Yemen,
- Far East: East Timor and Fiji.



Assumptions

- Minimize risk to US forces/treasure/personnel
- Well-defined desirable end situation

The working group adopted two very important assumptions. First, the group assumed that US commanders will be under an imperative to limit the risk to US forces, treasure and particularly personnel. Coercive operations can pin down or cause loss of force structure. Hence, commanders are expected to minimize risks to elements of force structure and the state of readiness of forces to meet other needs. While lives would not be put at risk to save money, operations would be planned in ways that minimize the risk of US assets. Hence, quick operations are to be preferred to drawn out ones, operations that employ weapons systems in situations that maximize their impact (and therefore their cost effectiveness) would be preferred to operations that employ large forces inefficiently, etc. Moreover, US commanders are under guidance that makes them very aware of risk to US personnel. The working group believed that this guidance would be an important factor in US decision making.

The second key assumption adopted was that US and coalition commanders would seek to establish clear and well defined goals or end situations. Recent experience has shown that poorly defined end states complicate military missions and often lead to ineffective operations. Hence, clear agreement among coalition partners, within the US government, and across the international organizations involved in coercive operations were seen as an important enabling condition for success.



Broad Mission Objectives

- In the event of a coercion operation the United States' objectives in entering conflict will be
 - Strategic
 - Prevent major bloodshed (genocide)
 - Prevent use of Weapons of Mass Destruction (WMD)
 - Stop genocide if it starts
 - Protect American lives
 - Preserve the free flow of vital natural resources (such as oil)

Broad Mission Objectives

At the strategic level, the US can be expected to undertake coercive operations for any of the national strategic interests. These include protecting the lives of US citizens, preventing the use of weapons of mass destruction, the protection of global oil supplies preventing major bloodshed (or halting it when it has already begun), and other interests identified by the National Command Authority.



Broad Mission Objectives (cont'd)

- Operational: Graduated response options
 - Persuasion
 - Threaten/Deter
 - Demonstrate
 - Disable
 - Defeat
 - Punish

From the perspective of the operational commander, coercive operations will normally be undertaken along a ladder of graduated response options. This ladder is designed to accomplish US goals with the least possible expense in terms of national treasure and the lowest risk to US forces. The ladder recognizes six levels, beginning from the objectives that require the least involvement from the Department of Defense (and relies therefore more on diplomacy, economics and other arenas) through those that are predominately military with modest support from other arenas

Graduated response options range across six generic levels:

- | | |
|--------------------------|--------------------------------|
| - Persuasion | - Disable Adversary Capability |
| - Threaten/Deter | - Defeat Adversary, and |
| - Demonstrate Capability | - Punish |

This sequence is based on the assumption that adversaries are subject to classic conditions of deterrence. That is:

- The adversary knows there is an action the US wishes them to take or avoid (for example, commit atrocities against a minority population);
- That action is within the target's power;
- Some value of the target is threatened;
- The threat is more negative than the value of the behavior; and,
- The threat is credible.

Finally, the theory of coercive action requires that the US be willing to carry out the threat.



Progressive Measures Toward Compliance

- Immediate indications (that change is afoot)
- Agreement(s) between parties
 - Create conditions for compliance
 - Cover end of hostilities and subsequent behaviors
- Return to normalcy
 - Refugee returns
 - Return to barracks
 - Normalcy indicators
 - Schools - Infrastructure
 - Commerce - Telecommunications
 - Recreation - Agriculture

Measuring progress towards compliance

The MOEs unique to coercive operations are those that indicate compliance by the adversary. Three classes of indicator are needed:

1. Indicators that immediate actions are being taken to comply with the coercive demands;
2. Agreements by the parties that indicate an intention to comply over time; and,
3. Indications of return to "normalcy" or the *status quo ante*.



Criteria for Compliance Indicators

- Specifically related to compliance
- Behavioral orientation(not belief)
- Cross-cutting measures (military, political, economic and social)
- Bolster agreements that lead toward lasting termination of hostilities on favorable terms

The need for compliance indicators and their importance were underscored by the priority that the working group placed on making them high quality. The criteria for quality indicators were seen as including:

- Direct relevance — the indicators should be direct reflections of the target's willingness to comply.
- Behavioral — based on concrete observable actions, including public statements, but emphasizing concrete irreversible actions. In other words, watch what the target does, not just what the target says.
- Cross-cutting — involving military, political, economic and social arenas and many facets of each. Deception plans will tend to emphasize one or two actions or arenas in order to mask efforts to evade compliance on other fronts.
- Long term — the actions taken should bolster reaching and implementing agreements that deal with the roots of the conflict and reduce the means by which that conflict can be carried on or re-ignited.

The working group spent some time discussing relatively specific compliance indicators, particularly those that would provide evidence that an adversary was in the process of complying or exploring how to comply. The indicators considered came from a variety of different types and often reflected recent US experience.



Create and Maintain High Quality Current Situation Understanding

- Common Relevant Operational Picture (CROP)
- Identify relevant actors (individuals, organizations, groups)
 - Value hierarchy
 - Intentions
 - Capabilities
 - Linkages
- Time vector (prediction)
 - Multiple futures
 - Adaptive behaviors
 - Predictive
- Need:
 - Pre-crisis knowledge preparation of the battlefield
 - Directory services (SME, etc.)
 - Existing system for capture, storage and retrieval of data, information and knowledge

Coercive operations require the ability to create and maintain a high quality understanding of the current situation. This can be developed and maintained through a variety of means, including:

- CROP that enables consistent data and information across echelons and functional arenas. Note that a CROP does not mean identical data, information or displays.
- Identify relevant actors (individuals, groups, organizations, external entities). In particular one must know these things about each actor:
 - What does each actor consider valuable to his purposes?
 - Capabilities (military, economic, political and social)
 - Intentions (what is their hierarchy of strategic, operational and tactical purposes?) In certain circumstances, it may be necessary to develop a military approach that deters an operational purpose on the part of one of the belligerents while at the same time avoiding presenting an ultimate threat to the belligerent's strategic objective.
 - Linkages and dependencies between relevant actors, which define opportunities for indirect influence as well as impacting data and information flows.

The phrase "current situation understanding" may prevent the reader from fully appreciating the role of time in the required process. While a great deal of the effort in the intelligence and blue side reporting is focused on describing the current situation, failure to provide a rich time vector will severely limit the value of the situation understanding. Good quality understandings extend into the future. They specify multiple possible futures that depend on the interaction between the operating environment, adversary forces and friendly forces. They also account for adaptive behaviors by all the parties involved, including refugee populations and other "non-force" actors. In essence, situation understanding that is not predictive is of limited utility to coercive operations. Commanders are seeking, in all cases, to influence future behaviors and situations, so their support must extend forward in time and across key uncertainties.

A great deal of pre-crisis preparation is required to rapidly achieve this sort of situational awareness. This so-called Knowledge Preparation of the Battlefield (KPB) is more extensive in nature than the IPB made famous by Army Field Manual 100-5. KPB should include as much of the data above as is known as well as a directory of services and Subject Matter Experts (SMEs).



Connectivity

- Who:
 - US DoD
 - US agencies
 - Coalition partners
 - Third parties (NGOs, businesses, etc.)
 - Adversary
- What: Data, information and knowledge
- How:
 - Sharing
 - Collaboration
 - Coordination
- Need: Tools for dynamic capture and analysis of architectures

The working group noted the wide variety of entities and individuals who must be connected in order to conduct an effective coercive operation. Normal warfighting requires connectivity within DoD, with limited interfaces with other agencies of the US Government. However, effective coercive operations require rich linkages within DoD (for example, across several echelons, involving public affairs and information operations specialists) as well as with a variety of other US Agencies (intelligence community, State Department, Department of Energy, etc.) and coalition partners. A variety of third parties (NGO's, PVO's, international businesses, media, and so forth) will also be involved.

Finally, communications with adversaries and other parties to the behavior the US is seeking to encourage or deter are also essential. The very act of influencing behavior demands some form of communication. Both the requirement that the target be aware of the desired behavior and the requirement that the behavior be within the capability of the target require communication.

These connectivities clearly vary in several ways. All must carry data, information, and knowledge. Some will only be used for sharing data, information and knowledge. Others will be used for collaboration (working together toward a common purpose) or for coordination of actions. Some will also include information assurance considerations.

The working group saw a very real need for tools that could capture and manipulate the architectures needed to map, evaluate and improve the architectures that provide this connectivity. These would be very valuable C4ISR analysis and planning tools.



Connectivity for Coercion Ops

Proposed actions:

- Encourage/support efforts such as The Federal Agencies Information Architecture Working Group (FAIAWG) to identify architectures and processes for information sharing with full range of coercion operation actors
- Support efforts to create Multi-Level Security (MLS) for information sharing
- Identify collaboration requirements for coercion operations to the Collaboration Interoperability Working Group (CIWG), and the Multi-media and Collaboration Tools Working Group (MCTWG) of the DII-COE
- Find "champions" such as ASD/C3I, SOCOM, JFCOM or the JWAC to provide more visibility and represent coercion operations in the CIWG

Beyond identifying and applying tools for capture and manipulation of the complex architectures involved in coercion operations, the working group also identified four specific, concrete, initiatives that could be pursued productively.

First, efforts toward Multi-Level Security (MLS) for data and information sharing need to be better supported. Dealing with a variety of non-DoD actors makes it imperative that information assurance be provided to all parties.

Second, the Federal Information Architecture Working Group, which exists to identify architectures and processes for information sharing within the US Government should be supported and asked to give priority to those actors likely to participate in important national security initiatives such as coercive operations.

Third, because collaboration and collaborative planning are so very important in these operations, DoD's Collaboration Interoperability Working Group (CIWG) and the Multi-Media and Collaboration Tools Working Group (MCTWG) of the DII-COE should be encouraged to look at coercive operations as a priority arena.

Finally, one or more "champions" to represent coercion operations in the CIWG and elsewhere should be actively sought. ASD/C3I, SOCOM, the JWAC and/or JFCOM are the natural candidates.



Investment in Development and Validation of Tools and Techniques for Transforming “Soft” Data

■ Data generation

- Case based reasoning
- Elite network analysis
- Cultural logic
- Influence networks
- Dynamic network analysis
- Agent based robotics

■ Data analysis

- Systems dynamics
- Complex adaptive systems
- Network simulations

Analysis of a variety of complex problems must be done to support coercive operations. These include identifying targets for International Public Information (IPI) and IO efforts as well as examining the logics that appeal to foreign cultures and the patterns of influence and cause within foreign societies.

Much of the past work on these topics has been done by SMEs and is considered more of an art than a science. However, a variety of tools have emerged that convert this type of “soft knowledge” into data and information that can be used to conduct formal analyses. Some of these identified by the group are primarily data creation or data capture devices, such as:

- | | |
|--------------------------|----------------------------|
| - Case based reasoning | - Dynamic network analysis |
| - Elite network analysis | - Influence networks |
| - Cultural logic | - Agent based robotics |

The group identified other tools to perform data analyses important for coercive operations, including:

- Systems dynamics
- Complex Adaptive Systems (CAS)
- Network simulations

Many of these tools have a basis in the social sciences. Traditional military OR analysts will need training to use them. In addition, new analysts from the social sciences need to be recruited to exploit these tools

Many of these tools will require further development or refinement before they can be applied quickly and effectively to coercive operations. Many can also apply effectively to other types of military operations. However, serious investments are needed in these areas.



Synchronize Development and Application of IPI and IO

- IPI Plan establishes formal US policy explanation for media and public diplomacy
- IO includes information assurance, psychological operations, disinformation, deception, attacks on adversary communications and computer systems
- Each need:
 - Identified target audiences
 - Means to deliver targeted messages
 - Meaningful MOE and MOP

There are two similar but different efforts that must be synchronized for maximum effect in coercive operations. First, the State Department is the lead agency for establishing and propagating any official explanation of US policy. Outlets for this type of transparency are the press and broadcast media as well as official US government public diplomacy.

On the other hand, leadership of IO are likely to be assigned to the Department of Defense. These operations involve information assurance, psyops, disinformation, deception, as well as other attacks on adversary communication and computer systems. Clearly, it is important that these operations not be working at cross purposes.

Both IO as well as IPI require some of the same discipline in execution: clearly identified audiences, the means to send targeted messages to those audiences and meaningful measures to track the progress of these operations on the overall coercion campaign.



C4ISR Data (Connections, Usage, Etc.)

- Extraction from
 - Real world operations
 - Exercises
 - Experiments
 - Models
 - Simulations
- Organization
 - Types needed
 - Standardization
 - Verification
- Circulation

Many of the C4ISR analyses, models and simulations the working group could envision as important were also seen as very difficult because the data necessary to support them are not readily available. As a result, the group made a strong recommendation that **a serious effort be made to extract, organize and disseminate basic information about the connectivity and communications usage patterns within DoD.**

C4ISR data extraction is possible in a variety of venues. Much of the real world experience of US forces is instrumented because it must be maintained or because its usage is metered. Exercises and experiments provide rich venues that can also be instrumented, but only if decisions are made well in advance. Models and simulations are often used to examine alternative architectures or the impact of specific changes on performance.

As discussed in a point paper provided to working group participants, these data need to be organized into types or classes, standard formats for storing and retrieving them should be created, and processes for verifying them for research purposes should be put into place.

More than anything else, however, these data need to be made available to the C4ISR research community. In the past, a series of legitimate, but manageable concerns (security, protection of unit information, desires for Service or Command lead in data analysis) have been allowed to prevent dissemination of data from real world operations, exercises, simulations and even experiments. If we are to build a C4ISR community with useful tools, we must break down these barriers and create mechanisms that share data more widely.



Visualization of Coercive Battlespace

- Branches and sequels along the graduated response options continuum
- Compliance indicators to measure the behavior of the belligerents
- Branches and sequels will be keyed to thresholds of compliance indicators

As indicated above, coercive operations are planned as a ladder of graduated response. Each new rung in the ladder is a contingency plan that needs to be initiated given the success or failure of the previous phase of the operation. In order to responsively move such a sophisticated plan along, the commander needs adequate and timely information needs in order to visualize the status of the coercive campaign and to justify the choice to move to, or refrain from moving to, another phase, branch or sequel of the operation.

Compliance indicators will serve as important inputs to the on-going assessment process. A series of assessment phases may be defined as follows:

- Phase I—Did my attack or coercion activity hit the intended target?
- Phase II—Did my attack or coercion activity manage to influence the system attributes in the intended way?
- Phase III—Did my attack or coercion activity affect the entire network (or system of systems) in the intended way?

This type of assessment activity can be used to judge the effects of kinetic weapons as well as the information campaign that is being run to change the minds of belligerents.



Measures of Merit (MoM)

■ HQ planning MOE

- Elements of a plan

- Missions
- Assets
- Boundaries
- Schedules
- Contingencies

- Effectiveness/MOE

- Plan is good for x% of temporal goals
- Percent of elements requiring no change
- Percent of time with no effective plan
- Time from requirement for new plan until new plan created

A plan consists of four elements, it may change a previous plan in any one or more of these elements, or establish an entirely new and different plan. A plan may also consist of several contingencies, branches or sequels. The elements of a plan are:

- Mission(s)
- Assets (task organization)
- Schedule(s)
- Boundaries
- Contingencies recognized within the plan

A plan can be measured by the fact that it lasted as long as was planned to last, normally stated in hours or days. The percentage of the above elements that require no change. The percent of time where no plan is in effect. Finally, the interval between when a new plan is required until it is created.



HEAT Measures of Merit

- Monitor measures
 - Complete
 - Current-timeliness
 - Correct-precision
 - Consistent
- Understanding
 - Integrated
 - Cognitive (between the ears)
 - Correct/incorrect/not incorrect
- Decision
 - Alternatives considered
 - Predictions-multiple futures across coercion continuum
 - Schedules
 - Connectivity tools
 - Collaboration
 - Cooperation

Definitions of Headquarters Effectiveness Assessment Tool (HEAT) measures are as follows:

–Monitor – The quality of monitoring is measured by directly comparing the information held by the command center with reality of ground truth. Also measured are the age of the information and the impact of erroneous and/or late information on the staff decision process.

–Understand (Assess) – The basic situation assessment measures. The quality of understanding is measured by comparing the accuracy of stated situation assessments with ground truth or reality. There are three terms used to describe the quality of the understanding – “correct,” “not incorrect” and “incorrect.” This construct is based on the premise that most staffs will generate what they consider the most likely situation and others considered less likely but within the realm of probability. An understanding is considered “correct” if the situation considered most likely corresponds to the actual situation. If one of the less likely understandings corresponds with the actual situation, then the understanding is considered “not incorrect.” If none of the expressed situations corresponds with the actual situation, then the understanding is considered “incorrect.” In addition to quality understandings are evaluated for completeness, and for the time covered (i.e., how far into the future the staff projects the situation).

–Decide – Although the decisions are not measured directly, the plans generated from those decisions are evaluated. The plans are measured in terms of quality, that is, the ability of the plan to come to fruition in the environment without the need for major changes; and in terms of the capability to degrade gracefully when changes are required.



HEAT Measures of Merit (cont'd)

- Directive
 - Consistent with Commander's decision (s)
 - Clarity
 - Consistent with plan elements
 - Reporting
- Cycle returns to monitor execution of plan and environment

Direct – The direct measures evaluate the directive's effect on subordinates and compatibility with the environment. They include the adequacy of lead time, plans aborted because the directive was received too late to implement, and timely responsiveness to queries.



Summary

- Coercive operations are a subset of traditional military actions
- Graduated response ladder drives coercive operations
- Compliance indicators are a new and crucial form of MOE
- Pre-crisis KPB is essential
- Rapid creation and manipulation of C4ISR architecture:
 - Data extraction is a priority
 - Dynamic, adaptive tools are essential
 - Red side must be captured

Coercive operations have often been a subset of traditional military operations, but they take on a special significance for US military operations in the post-Cold War period. The essence of coercive operations requires a graduated ladder of escalation.

The management of coercive operations will require a sophisticated set of compliance indicators. As explained above, the commander will need this sort of information to adjust his plan in synchronization with the belligerent's behavior changes.

The knowledge required to both identify the proper measures of belligerent behavior as well as assess their meaning demand that a good deal of knowledge must already be available and understood before the coercive operation begins. This pre-crisis knowledge is called Knowledge Preparation of the Battlefield (KPB).

A rapid creation of a communication architecture is necessary both to receive the information relevant to compliance indicators as well as communicating the right signals and warnings to the belligerent parties.



Summary (cont'd)

- Investment in tools to transform “soft” data and information into operations research quality data are necessary
 - New OR analysts; new training for old analysts
 - Data generation
 - Modeling, simulation and analysis
- IPI and IO are more important in coercive operations

Much of coercion operations involves an understanding of the behavior of belligerents who are acting inside of their own perception of the problem and their own cultural predilections. Some investment is needed today to develop tools and methodologies to transform this “soft” data in the social/cultural arena into research quality data for OR.

Because coercive operations involve the deterrence of belligerent behavior, both IPI and IO must receive especially important attention. Failure to provide attention to these important arenas has meant that they were marginalized during real world operations.



Summary (cont'd)

- Commanders and key staff require new training and perspectives:
 - Theory of conventional deterrence
 - Transparent battle management tools
 - Multi-sided situations
 - Balance short and long term objectives (keep your eye on the “end-state”)

In translating strategic objectives into operational objectives, the military professional needs a theory of deterrence or a theory of coercion. During the Cold War there was a great amount of expertise and understanding of strategic nuclear deterrence. However, since the end of the Cold War, there is no similar body of understanding on how the military can deter or coerce in the kinds of clashes represented by the 10 case studies. There is a need for a theory of coercion in order to derive the military objectives at the operational level as well as the C4ISR requirements to support the operational level of this type of warfare.

Coercive operations are not new, but the nature of these post-Cold War military operations are likely to have three features:

1. The use and threatened use of military force by the US will include conventional weapons only — no nuclear weapons.
2. The US may not be a principle belligerent; rather, the US will attempt to influence the struggle between two other opposing factions. Sometimes these opposing factions will be within a nation as opposed to fighting across international borders.
3. The US will not be “picking a side,” but will endeavor to use US military force to change the calculations of the two belligerents.



Summary (cont'd)

- Commanders and key staff require new training and perspectives:
 - Theory of conventional deterrence
 - Transparent battle management tools
 - Multi-sided situations
 - Balance short and long term objectives (keep your eye on the “end-state”)

Coercive operations should be planned as a graduated set of responses. The nature of these new post-Cold War military confrontations requires close study of the theory of deterrence. Perhaps Edward Rhodes has made a good start:

- “Many potential adversaries are, at least at times, undeterrable.” (This is a highly cautionary conclusion)
- Conventional deterrence is strengthened if US actions and threats can be interpreted by the potential adversaries as denying their “ability to achieve a quick military victory and political *fait accompli*.”
- “In the event that deterrence fails and aggression occurs, threats to use conventional military force to impose pain and destruction on the adversary’s society are less likely to compel the aggressor to make peace than are threats to defeat its military forces and to deny it its politicomilitary objectives.” (quotations from Edward Rhodes, “Conventional Deterrence,” *Comparative Strategy*, Volume 19, 2000, page 221-223.



Appendices

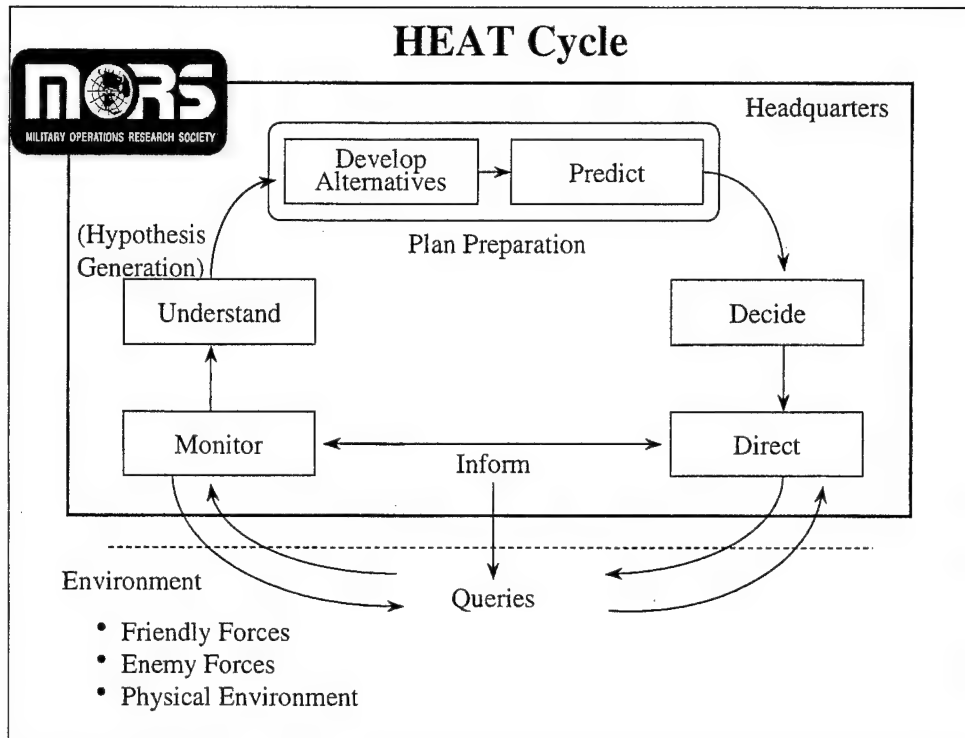
- (A) Study plan
- (B) Scenarios
- (C) Headquarters Effectiveness Assessment Tool (HEAT)
indicators of command and control quality
- (D) Notes from the Coercion WG (Col David Anhalt)
- (E) Specific Examples of Compliance Indicators (U)
- (F) Constraint, Restraints and the Role of Aerospace
Power (Briefing by Lt Col Jeffrey K. Beene, US Air
Force Fellow)
- (G) Bibliography

This report is supported by seven appendices, which should be consulted by those who want to understand the working group efforts in more detail.



WG 2 - Coercion

Back Up Slides



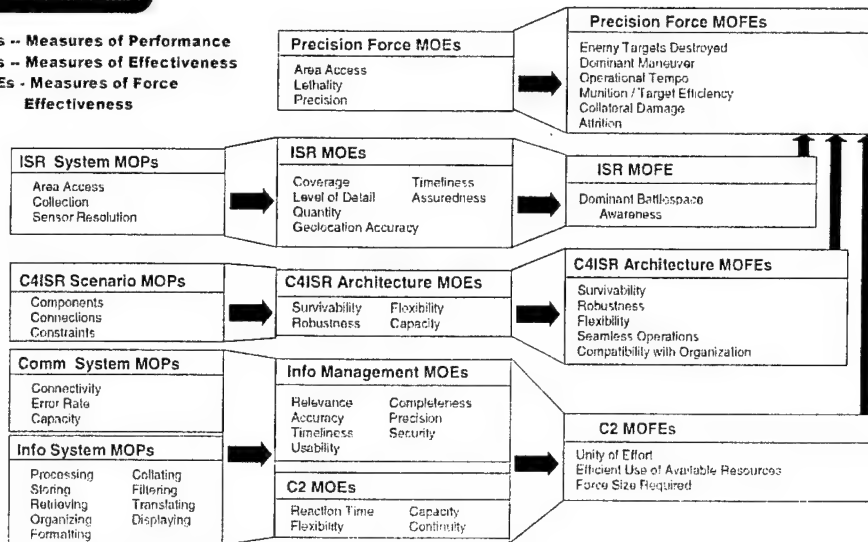
The focus of HEAT is on the command and control processes of a Command staff. The basic organizing device is the control cycle, quite similar to the OODA loop.

HEAT comprises about 256 measures, depending on the scope of the evaluation. However, most of these measures are subsets of the basic measures built around the steps of the control cycle. HEAT always conducts operations within an environment which consists of friendly forces, enemy forces, political, economic and geographic features.



Measures of Merit Threads

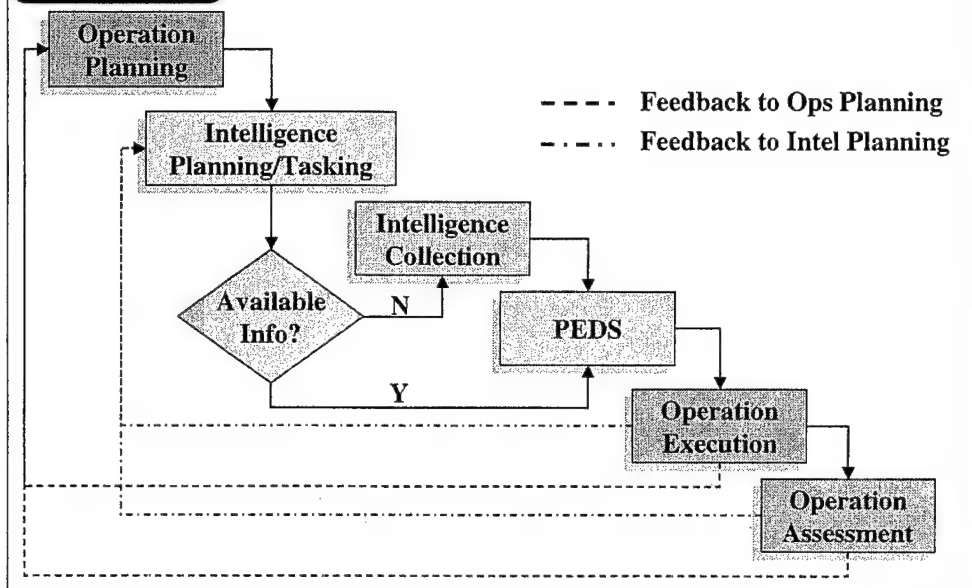
MOPs -- Measures of Performance
MOEs -- Measures of Effectiveness
MOFes - Measures of Force Effectiveness





ISR Architecture Analysis

- Concept





Working Group Report WG 3 - Urban Operations

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To address the specific tasks associated with the C4ISR Workshop, the Urban Operations Working Group used detailed discussion to level the playing field. This was necessary due to the varying MOUT and C4ISR knowledge- and experience-levels of the working group's participants.



Background

- The Urban Operations Working Group
 - Needed to level the playing field
 - Dealt with analytical problems and complexities in two major subject areas: Military Operations in Urban Terrain (MOUT) and C4ISR
- MOUT Simulation is Challenging
 - Many diverse acquisition programs, all in their infancy
 - Complex "terrain" and socio-political representations required
 - No single focal point exists to support needed research
- The urban environment presents unique challenges to military operations and C4ISR

One problem faced by the working group was the number of diverse new programs now underway to address military operations in urban environments. This situation, combined with the primitive state of understanding concerning MOUT simulation, required that the group gain a comprehensive overview of a complex set of issues. Moreover, despite the increased likelihood of MOUT involvement by US forces, as well as the complexities of operating in such an environment, there still exists no single champion or proponent to address MOUT issues. The absence of a single focal point impedes efficient and effective progress.

The urban environment presents a host of other unique challenges to military operations and C4ISR. The presence of non-combatants, for instance, often leads to strict Rules of Engagement (ROEs) and numerous potential legal constraints. The densely compacted nature of urban areas, the presence of many different types of structures, and the three-dimensional (and subterranean) nature of cities present a host of difficulties including: 1) limited use of indirect weapons; 2) the necessity of fighting small-scale, separate engagements both in and around buildings; 3) very limited lines of sight, and little or no way to detect activities inside of buildings or in underground structures; 4) problems in navigating and identifying troops' position-locations, due in part to the limited utility of GPS in the urban canyon; 5) difficulties discerning the location of friendly and enemy troops and the situation on the ground; and, 6) a variety of electromagnetic blockage, reflection, refraction, and diffraction phenomena which increase radio transmission path losses and multi-path effects.

In addition, the multiplicity and high density of radios and other electronic devices — friendly, enemy and civilian — in cities increases the potential for frequent cases of radio interference and Electromagnetic Interference (EMI) effects.



Urban Operations Working Group Issue

What investments in resources are needed to provide an integrated and viable C4ISR capability to meet the needs of urban operations?

The Urban Operations Working Group was originally given two strawman questions:

- What C4ISR investments would support precision engagement and dominant maneuver requirements in urban operations?
- What C4ISR investments may trade/substitute for precision engagement weapons/platforms and maneuver forces in urban operations?

These questions were intended to reflect the study's purpose. However, owing to the current rudimentary understanding of interrelationships between urban operations and C4ISR, the working group, wrote its own more general question from which to develop a meaningful dialogue.



Assumptions

- Operations in the urban environment will be a major contributor to the operational tempo of the US Armed Forces in the period 2000-2025
 - Demographic trends
 - Mission areas
 - Asymmetric threats
- Such operations will cover the full spectrum of conflict
- US forces must be better prepared than at present to successfully execute MOUT
- Urban operations will be conducted with the additional intent of limiting all casualties and collateral damage

Several factors suggest that, in the future, the US armed forces will be increasingly called upon to operate in the urban environment — an environment where US forces' effectiveness and advantage is eroded. First, as the world population grows from 6 billion to nearly 9 billion by the year 2025, the number of cities with over 1 million inhabitants will grow from 300 to 500. The modern phenomenon of migration from rural to urban areas will continue, as will high birth rates and urbanization in third world nations. Demographers estimate that 75-80 percent of the world's population may reside in cities by 2025.

Secondly, many of the missions assigned to US forces in the post-Cold War era have involved, in part, the care or control of civilians and, as seen above, cities will be where most people reside. Moreover, cities will remain cultural, economic and political seats of power; their safety is key to many US post-Cold War objectives. Finally, whether the United States wishes to fight in cities or not, future adversaries may leave us little choice. Potential adversaries have concluded from the Gulf War and elsewhere that the US military is not to be taken head on in open terrain. The US technological advantage may be minimized by fighting in the close, confined environment of urban areas while gaining instantaneous access to the international news media.

Future operations in urban environments can be expected to cover the full spectrum of military activities, from high-intensity combat against professional militaries down to the peaceful distribution of food and medical services to civilian populations. Indeed, former USMC Commandant General Charles



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Krulak visualized a full spectrum of operations — high intensity combat, peacekeeping and riot control, and humanitarian operations — taking place concurrently over a small area in his “three block” war.

In an age of 24-hour global news coverage and continuous public exposure to military operations, urban operations will likely be constrained by the objectives of limiting casualties and collateral damage, through strict ROEs.

The experience of the US and other militaries in urban operations over the past ten years strongly suggests that US forces need to be better prepared to face the urban environment. More than a dozen studies stretching back nearly 30 years (including an oft-cited 1994 Defense Science Board MOBA study), have pointed out the shortcomings of the US military in conducting urban operations. Of the many recommendations made by these studies to alleviate MOUT problems, few have been completed, including required improvements to urban information systems, simulation capabilities and databases.



Broad Mission Objective

- In the event of an urban operation, the United States' objective will be:
 - Contingent upon assigned mission (offensive ops to retake/capture a city; peacekeeping; counter-terrorism/WMD; humanitarian operations)
 - Highly scenario dependent

The urban operation is not an end in itself. Instead, it is linked to specific missions that range from: 1) high-intensity offensive operations to capture or retake a city; 2) defensive and counter-terrorism operations; and, 3) providing humanitarian aid as part of OOTW.

Historical data suggest that urban objectives and missions will be highly dependent on the scenario at hand. Future urban operations could take place within or outside the border of the continental United States. The military may or may not be able to take advantage of existing C4ISR infrastructure resident in, or over, the area of the operation.



Impact of C4ISR on Mission Success

- Increase Situational Awareness
 - Observer/data collection/monitor capabilities
 - OODA Loop (Observe/Orient/Decide/Act)
- Achieve Decision Superiority in order to:
 - Increase tactical agility
 - Select and attack appropriate targets when required
 - Maximize effect while minimizing force
 - Achieve desired OpTempo
- Improve Precision Strike and Its Assessment
- Improve Maneuver

The principal impact of C4ISR on mission success in urban environments will be its contribution to overall situational awareness, decision superiority, precision strike, maneuver and force protection.

Situational awareness might be considered analogous to the observation portion of the OODA loop.

C4ISR can dramatically impact mission success through its contribution to achieving decision superiority, which then allows for achievement of the maximum effect with minimum force, the selection and attack of appropriate targets, achievement of the desired OpTempo, and increases in tactical agility.

The precision strike cycle will include target acquisition, precision strike, and Battlefield Damage Assessment (BDA). The maneuver cycle is defined by orienting on the situation and moving forces precisely where needed, while, through mobility/counter-mobility operations, denying the enemy the same opportunity.



Measures of Merit (MoM)

- In the conduct of an urban mission, the means by which we measure ultimate success are:
 - Traditional range of measures (e.g., LER and FEBA movement)
 - Other measures dealing with
 - Efficiency/effectiveness, accuracy, and timeliness of data/information
 - Noncombatant casualties/collateral damage
 - Cultural factors
 - Ability to collect and assess BDA/BDI
 - Control of the battlespace (time to accomplish mission, etc.)
 - Situational awareness
 - Innovations emerging from current studies.

Traditional measures of merit, such as loss exchange ratios and rate of FEBA movement, will continue to be important, particularly when trying to understand the force effectiveness implications of C4ISR capabilities. Non-traditional measures, however, will also be required to characterize the effects of C4ISR on MOUT. These might include levels of unintended damage to civilians and infrastructure, time to complete the mission, and likelihood of achieving the desired end state. Measures of information accuracy, timeliness and completeness will be required, along with measures that capture the efficiency and effectiveness of actions (or prevention of enemy action) based on that information.

In support of precision strike, measures are required for target acquisition; the ability to collect and assess BDA and BDI; and assessments of casualties, collateral damage and other effects on the populace. In support of maneuver, measures will be required for detection of hot spots (to avoid or respond to) and gaps to exploit for movement or positional advantage.

Measures of situational awareness must include the value of targets, their geographic or geometric positioning, and threats to political "high-ground." Other measures may need to be examined, including innovative information assurance metrics and other measures currently under study.



Analytic Method

- We will test these hypotheses by using a layered, joint approach and employing a model-test-model paradigm:
 - Using limited available models which both represent the MOUT environment and have the capability of accepting C4ISR inputs from other tools
 - Conducting warfighting experiments where both C4ISR and MOUT explorations are possible
 - Taking advantage of existing urban operations explorations (both DoD and first/second responder communities) by emphasizing C4ISR aspects

Analytic methods for assessing approaches to urban operations remain largely dependent on the purpose of the analysis to be performed. However, be it for technology investment, planning, training, or policy insight, all need a comprehensive, inter-linked analytic approach. The approach described here applies not only to the question raised at the start of this brief, but provides a more comprehensive approach to MOUT and C4ISR analyses.

Currently, there is no single modeling effort addressing these separate areas of analysis. However, interim modeling solutions (such as JCATS) for parts of the MOUT problem do exist. Innovation and imagination are required to apply emerging approaches to initial assessments of the urban/C4ISR problem set, as well as to identify the limitations.

In addition, a range of experimentation into the politico-military aspects of urban conflict need to be conducted — from map-exs to field exercises to historical case studies. The purpose behind these activities is to provide insight into appropriate methods and procedures, not providing a “final” solution. A principle component might be the development and evaluation of organizational and operational plans for fighting in an urban environment with and without a variety of C4ISR assets or infrastructure.

The US military is currently embarking on a number of MOUT-related activities, both single service and joint. We need to take advantage of these efforts by ensuring that they include and, when appropriate, emphasize C4ISR aspects. Moreover, a large body of work has been amassed by militaries as well as police and fire departments of several nations on how to deal with urban



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situations — e.g., post-mortems on the 1992 Los Angeles riots, plans for the 2000 National Conventions in Los Angeles and Philadelphia, the British Army in Northern Ireland, the Israeli Defense Force and the New Zealand plans for East Timor. All of these sources, military and non-military, can provide information, insight and data to feed an improved analytic approach in urban environments.

Collection, synthesis, reduction, examination and distillation of data/information into a form usable by DoD or other analysts will require a directed effort and standard or compatible data formats. This effort must have clear operational purpose, and provide an improved ability to predict the impact of sufficient (or incomplete) C4ISR.



Scenario

- We will employ variants of Northeast Asia, Sub-Saharan Africa, and other yet-to-be-defined scenarios (including homeland defense) to analyze the full range of urban C4ISR issues, e.g.:
 - Offensive operations to regain control of city
 - Defensive operations to retain control of city
 - Noncombatant Evacuation
 - Humanitarian assistance/disaster relief
 - Consequence management/direct actions to minimize impact of WMD
 - Transition

To assess C4ISR issues in MOUT— when a number of different types of military operations might occur in a wide variety of city types — requires examining multiple scenarios within widely disparate urban environments. For example, a variant of the MTW scenario associated with Seoul, a Smaller Scale Contingency (SSC) set in and around a large urban area in a relatively poor nation (such as found in Sub-Saharan Africa), and other ill-defined scenarios, including US military forces (active or reserve) involvement in homeland defense should be considered as part of the design objective.

Within these scenarios and environments, a number of military operations ranging across the spectrum of conflict will need to be studied, including offensive operations to regain control of a city, defensive operations to retain control of that city, humanitarian assistance and countering terrorist use of WMD.



Data

- Performance data will be obtained from ongoing efforts at appropriate centers. This requires coordinated effort with the centers to ensure collection capability and intent
- Threat data will be obtained from the intelligence community by ensuring that on-going MOUT efforts include C4ISR considerations
- A glaring need exists to develop better urban information *systems* and supporting terrain, politico-cultural and demographic data

Several classes of data will be required to successfully model, analyze and operate in urban areas. Data types will vary according to user, class of question, level of activity (e.g., strategic, operational or tactical) and current scenario. The most stringent requirements may be for modeling precision engagements (e.g., hostage rescue, special operations and counter-terrorism options).

Performance data are required to represent C4ISR functions and hardware capabilities. These diverse data sets must capture the capabilities of sensor suites, communications devices, weapon systems and command and control functions within urban canyons (above, at and below ground level). The data must be available at varying levels of resolution and in formats appropriate to particular operational echelons (Corps and above, Division, Battalion and below) and uses. Specific data requirements include not only those for system performance, but also human performance, data fusion, information flow and bandwidth limitations.

Data on threat systems and capabilities are also required. This must cover not only physical space, but also the cyberspace environment used for information operations and information assurance (computer network defense and attack).

One of the most challenging data needs concerns the development of the urban information systems desired by the SecDef and others since 1994 for crisis and consequence management, mission planning and rehearsal, command and control, modeling and simulation, systems acquisition, and development of doctrine, tactics and other combat developments activities.



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Urban data must faithfully capture the urban terrain, including features such as buildings, utilities, lines of communication and “clutter” (impediments to intervisibility and mounted or dismounted mobility), as well as important subterranean facilities and infiltration routes. The Defense Science Board – MOBA study outlined several categories of information necessary to analyze, simulate, understand and operate in urban environments. These include:

- Cartographic intelligence (i.e., geospatial information, imagery and maps)
- Engineering intelligence (i.e., floor plans, capability, vulnerability and lethality)
- Operational intelligence
- Biographic intelligence (i.e., information on important leaders and factions)
- Institutional services data (i.e., food, medical, police, military...)
- Demographic and sociological data
- Political and administrative information
- Cultural, anthropological and linguistic information

Although highlighted more than 6 years ago, little progress has been made in developing a true multi-user urban information system. The DSB recommendations are still considered valid and the technologies now exist to produce the data and better decision aids. What is needed is the will and funding to do so.



Weaknesses of Approach

■ The major weaknesses with our approach are:

- Poor definition and limitations of the Urban-C4ISR problem
- Lack of understanding of the complexities of socio-technical systems of systems, and interrelationships of cultural, demographic, economic and political factors
- Dearth of operational concepts for the urban environment
- M&S tools that do not support 21st Century needs
- Absence of senior advocate/proponent for MOUT issues
- DATA, DATA, DATA

The major challenges faced by analysts in this domain are an absence of a well-defined problem set and the limitations of our understanding of urban operations and applications of C4ISR in an urban environment. Especially lacking is our understanding of the complexities of the socio-technical system of systems encountered in this environment, and the interrelationships of cultural, demographic, economic and political factors embedded in urban operations. A commonly accepted set of operational concepts for employing military forces in an urban environment is also lacking is.

For these and other reasons, current M&S tools do not support the needs of either the MOUT or C4ISR communities. Specifically, there are no models or simulations that address MOUT/urban terrain in sufficient detail and accuracy that the impact of a broad C2 or C4ISR infrastructure might be evaluated. A focused, well-funded developmental effort in this area must be implemented, with user needs sufficiently defined that an initial specific effort might be mounted — with generality to follow.

Analytic effort in the urban setting must be expanded from piston-type attrition modeling to representations that might rarely involve attrition events. A related problem is the shortage of good, verified data to support M&S and other analytical tools examining MOUT issues.

As previously stated, no high-ranking DoD-level advocate or proponent for MOUT issues exists — especially for developing urban information systems and requisite data libraries for likely urban hot spots.

Institutionalizing a strong proponent for MOUT-C4ISR is critical to well-coordinated future investments, proper training of warriors and analysts, and improved simulation capabilities.

Credible simulation of C4ISR in urban operations has become a severe deficiency. Lack of a strong proponent is viewed by this working group as the main reason for little analytic progress during the 1990s.



Conclusion

- Full solution to the urban/C4ISR MOUT analysis problem is dependent on the completion of road-mapping and/or solving DoD community's ongoing MOUT problem
- There is a "space-to-face" problem (many levels of resolution are required to evaluate MOUT operations)
- Given the state of our understanding of the analytical situation and current funding limitations, there is no predictable estimate of a time, date or place of a solution
- There are interim solutions in modeling for parts of the MOUT problem that can be used to begin assessments while better algorithms are built.

A complete solution to the urban/C4ISR analysis problems outlined here requires the completion of on-going efforts to develop and implement a roadmap for solving the DoD community's MOUT problem. At present, the specific needs of C4ISR in the urban environment are complex and unknown, therefore, the full set of analytical solutions become unpredictable in terms of time, date and place.

Resolving these issues in M&S is made more difficult by the "space-to-face" problem encountered in the urban-C4ISR arena: assets must be examined and integrated across the entire spectrum of operational scales from space-based reconnaissance and communications down to the individual warfighter on the ground.



Investments in Analytic Infrastructure

- Based on our identified shortcomings we recommend the following investments in the analytic infrastructure:
 - Analyst training
 - In urban/C4ISR issues
 - In cutting-edge geo-spatial/urban data base development tools/techniques
 - At next AFIT/NPS curriculum reviews emphasize courses in geographic information systems and urban modeling
 - Instrumentation and data collection, assessment and dissemination of MOUT/homeland defense tests
 - MOUT M&S development and *validation*
 - Pursuit of metrics and assessment of approaches for translating C4ISR MOPs into effects-based MOEs

Many analysts lack an appreciation for the subtleties and special problems arising from military operations in the urban environment. Moreover, most have little understanding of the C4ISR issues and problems, especially as they apply to urban operations. Training in these areas, therefore, is essential. In addition, recent advances in software in the areas of geospatial data base development can be used to enhance the knowledge concerning urban environments. Training analysts in urban data production could result in more accurate and timely information that can be used in modeling aspects of MOUT and to support actual operations. Inserting this training in the curriculum of military analysts is a straight-forward means of institutionalizing an urban C4ISR capability.

M&S to support the MOUT problem is not mature. There are applications that can be modified to allow modeling of parts of the MOUT problem. However, a comprehensive toolkit is lacking. After a basic tool set is generated, a more complete understanding of other areas to focus on will result from use of these tools in analysis. Required are physics-based, socio-cultural-based and operations-based tools. Finally, to gain acceptance these tools must be validated by both a broad inter-service analytic community and by relevant decision makers.

Data need to be collected for likely scenarios that support algorithm development. Some algorithms may already exist in other communities that could be identified and incorporated into MOUT models. In order to accomplish these goals, MOUT facilities and sites need to be properly instrumented, raw data must be processed into a form useable by the relevant M&S tools, and M&S users must be kept aware of data availability.

When a better understanding of the relationships in urban environments is captured and exploited through the use of tools and data, then C4ISR performance can be better evaluated via improved, effects-based measures of effectiveness in likely operational scenarios.



Investment Payoff

- MOUT M&S investments will result in improvements to analytic quality in the following ways:
 - Analysts better able to understand/assess the complexities of urban/C4ISR issues (places analysts in a more proactive posture)
 - M&S capabilities better able to represent MOUT, C4ISR capabilities/functions, and the translation of C4ISR into force effectiveness metrics
 - Improved analytical underpinning of quantitative evidence for the choices, trade-offs and solutions.

Investment in the training of analysts in the specialized areas just discussed will result in the development of a community well-versed in the complexities of C4ISR issues in urban operations — a community able to structure and decompose issues into appropriate study designs, as well as one capable of developing and assessing C4ISR within an urban context.

The development of the appropriate M&S tools and databases will result in: 1) a better representation of operations in the MOUT environment; 2) improved capabilities to assess C4ISR functions and tradeoffs in that environment; and, 3) the ability to visualize and explain in cogent fashion to decision makers the impact of C4ISR on combat capabilities and force effectiveness.

Together these efforts should result in improved analytical underpinning for the timely, quantitative assessment of urban C4ISR issues of concern to decision makers.



**Working Group Report
WG 4 - Peace Operations and Humanitarian
Assistance**

Bob Holcomb

Bob Smith



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WG 4 - Peace Operations and Humanitarian Assistance

Executive Summary



The Problem Statement

What modifications should we make to the analytical infrastructure to improve our ability to assess C4ISR effectiveness in peace operations and humanitarian assistance operations?

(While recognizing that PO/HA operations are fundamentally different than any that the analysis community has been called upon to deal with since World War II)



How We Propose to Address the Problem

We propose to begin by:

- First examining the overall mission objective of these operations
- Second by determining the MoM by which we determine the success or failure of the operations
- Third by examining how C4ISR contributes to the success or failure of the operation
- Finally by selecting MoM for the evaluation of the C4ISR contributions

We then propose to end by:

- Preparing a sample list of data which would support the C4ISR measures of merit
- Assessing the weak areas in the analytical infrastructure that inhibit assessing the C4ISR contributions
- Recommending investments in the analytical infrastructure which would then improve our ability to assess C4ISR



What's Good and Bad About the Plan

■ Good

- We have plenty of real world examples to follow
- It follows an organized approach
- We used a wealth of experienced people, both from within the analytical community and from outside it

■ Bad

- We have plenty of real world examples to follow
- PO/HA do not lend themselves well to the last 50 years of conflict-based analysis and model development
- Largely subjective in nature



Recommendations

- Educate analysts
- Change our analytical skill sets
- Improve data access, collection and management
- Develop tools
- Conduct operations analysis during operations



WG 4 - Peace Operations and Humanitarian Assistance

Final Report



PO/HA Working Group Issue

What modifications should we make to the analytical infrastructure to improve our ability to assess C4ISR effectiveness in PO/HA operations?

This is the problem the group set out to solve. The final answer was to be the changes in the analytical infrastructure necessary to improve our ability to assess C4ISR effectiveness in PO/HA



Assumptions

- "Good" C4ISR enables "good" command and control, which enables "good" decisions, which enables "good" outcomes
- "C4ISR" is fungible; it has value which can be traded
 - Against itself (UAV versus manned systems)
 - Against other forces (troops versus C4ISR)
 - Tradespace is a variable (money, bandwidth, airlift, etc.)
 - A resource for collaboration with stakeholders
- "C4ISR" in PO/HA differs from conflict operations

We had to make several assumptions in order to proceed, and they are listed on this chart. The first one is the most critical, as all else depends upon it. While there is no doubt that it is in general true, the precise linkages in the bullet are tenuous at best, and not well understood. We have assumed almost a linear relationship.

We also assumed C4ISR was a fungible thing, and able to be traded back and forth for other things. This assumption emphasizes the importance of being able to assess the value of C4ISR contributions to PO/HA.

We also made the assumption that there were differences in C4ISR in PO/HA. This appears to be borne out by the remaining charts, but nonetheless was an ingoing assumption.



Differing Characteristics of PO/HA

- Multiple chains of command
- Multi-organizational, with NGO, PVO, IO and non-state players
- Military is often in a supporting, vice a lead or supported role
- Multiple definitions and assessors of "success"
- "C2" is coordinate and cooperate, as well as command and control
- "Fog of Peace" can be more turbid than the Fog of War
- Heavily politicized environment, plenty of oversight, perceptions can outweigh reality
- Tempo is generally slower, but can change to violent and fast in a heartbeat
- Peace operations take a long time to create a stable environment and build trust
- Actions of junior officers and enlisted can have far reaching, even international, implications
- Complexity is not a linear function of force size

This chart presents a laundry list of some of the areas where PO/HA differ from other, more conventional operations. All of these can be elaborated upon, and the list is by no means exhaustive, but it is a good indication of the increased complexity of these operations and the tangled nature of their control. Even the definition of what constitutes success is not uniform or general, and several stakeholders may have conflicting definitions.

Time is a crucial variable in these operations. It may take a long time to improve the situation to the extent that the military presence is no longer required.



Broad Mission Objective

In the event of a US military involvement in a PO/HA, the US military force objective will be to foster an environment* such that the US military can depart without adversely affecting the stability.

*** The definition of this environment is unique to each operation**

This chart describes what the group felt was the broad mission objective that the US military force would have in the PO/HA.

Note that the precise definition isn't possible, because it will be dependent upon each individual situation as it unfolds.



Operation Measures of Merit

- In the conduct of this mission the primary means by which we measure ultimate success is:
 - When the environment is judged to be stable enough that the US military presence is no longer required, and their departure will not jeopardize that stability
- Progress towards this goal is measured during transition by secondary measures (*listed on the following two slides*)

The single overarching measure of merit, then, is the degree to which the situation stabilizes so that US military presence can succeed without deterioration.

As the mission moves towards this goal, progress is not binary but gradual, and some of the measures that can be used to indicate this progress are shown on the next two charts.



Operation Measures of Merit (cont)

- Secondary measures might include:
 - A free flow of information
 - Free flow of traffic over roads
 - An effective justice system
 - A functioning civil administration
 - A functioning school system
 - A functioning local economy
 - Reductions in civilian mortality rate
 - Reductions in military-related deaths

These measures are not intended to be all inclusive but a sample. In the absence of any more concrete ideas, they will serve as a useful starting point. A better set can then be refined from these.



Operation Measures of Merit (cont)

- More secondary measures might include:
 - Number of violations of peace accords
 - Starvation mortality rate
 - Populations of displaced persons camps
 - Functioning infrastructure (telecom network...)
 - Reduction in military involvement in providing services

Precise measures will vary by operations, are heavily situation dependant and are defined by multiple stakeholders

A question to be answered is whether those organizations left behind to continue the PO/HA mission after the military has departed should contribute to both defining relevant measures of merit (i.e., for environmental stability) and the criterion levels. The adequacy of stability to allow the military to exit is, at bottom, a military decision, but the mechanisms for assessing it should include soliciting this input from other organizational participants.



Operational Scenarios

- We used the following scenarios to analyze the issue:
 - Bosnia and Kosovo
 - Haiti
 - Somalia
 - East Timor
 - Hurricanes Andrew and Mitch, Rwanda, Sea Angel, Provide Comfort... etc, etc.

We focused on real world experience, since it was readily available

We did not rely on approved modeling scenarios because we had a wealth of real world experience upon which to draw. All of these were used at one time or another in our discussions.



How does C4ISR Impact the Operation?

- Systems: Opportunities (*and constraints*)
 - Provides information (*but not to everyone*)
 - Links deciders with actors (*but not all deciders*)
 - Decision support systems (*but not all deciders have them*)
 - Shared visualization of situation awareness (*but not to everyone, or including everyone*)
 - Provides collaborative planning tools (*but not for everyone*)

The C4ISR systems then can have an impact upon those measures of success in two general ways: by system or by process. This chart speaks to the systems aspects and the following chart discusses the processes.

Note that there are significant and repetitive “constraints” listed after each opportunity presented. This is because there are so many stakeholders in PO/HA missions who must be included as both data providers and as collaboration partners in the C4ISR processes.

Measures of effectiveness may be more readily determined in terms of reduction in the constraints.



How does C4ISR Impact the Operation?

- Process opportunities (*and constraints*)
 - Supports OODA loop decision making (*but not for every decision maker*)
 - Shares information on state of environment (*but an OPSEC barrier exists*)
 - Improves planning processes (*but complexity and interoperability issues abound*)
 - Supports information assurance process (*but complexity and interoperability issues abound*)
 - Increases coordination of efforts

Current C4ISR systems and processes were not designed for these environments, and their integration is not yet well understood

The current suite of systems we employ in the DoD were not developed with these missions in mind. The integration of this suite of systems, coupled with the addition of the civilian, allied and host nation systems, is poorly understood.



Suggested Measures of Merit **(Wisdom from BrigGen Elliott)**

- Include people: all stakeholders have measures of merit, not just DoD
- Insure relevance of measures of merit
- Know when to stop measuring and get on with deciding and acting
- "I" is more than intelligence platforms. All information sources, people, organizations are included
- Models are not adequate for these analyses; use real world experience

This chart recalls some of the points made by BrigGen Elliott to the previous workshop of this series, which we thought useful as a focus of our selection of merit measures. These are not all inclusive of her remarks, but provide a good cross-section.



Some Suggested C4ISR Measures of Merit

- Intelligence and information
 - Accuracy and timeliness of information and intelligence
 - Time necessary to disseminate products
 - Number and quality of HUMINT assets
 - Integration of multiple sources
- Planning and coordination
 - Time delay in OODA decision cycle
 - Number and quality of liaison teams necessary
 - Ability to generate and disseminate a common operating picture
 - Interoperability of disparate C4ISR systems

The following two charts describe some suggested measures of merit for the C4ISR assessment that the analysts have to accomplish. As with the previous laundry list, it is intended as a starting point, not as the all inclusive final answer.

The remaining three categories are listed on the next chart with some samples from them as well.



Some Suggested C4ISR Measures of Merit

- Tactical connectivity
 - Latency of message traffic
 - Bandwidth and frequencies required
 - Access availability to an Internet Service Provider (ISP)
- Coordination with non-military organizations
 - Number of organizations with whom liaison is established
 - Frequency and quality of relationship with organizations
- Cost and resources
 - Cost of network communications
 - Ratio of C4ISR manpower to total force structure
 - Cost to stakeholders



What Data Would Support These MoM?

(Sample List)

- Intelligence and information
 - Processing time for intelligence products
 - Dissemination methods and times
 - Percentages of PIRs answered
- Planning and coordination
 - Efficiency of data management
 - Planning timelines
 - Identification of key stakeholders, including their goals, functions, C4ISR capabilities and requirements
- Tactical connectivity
 - Bandwidth utilization, frequency allocation
 - Message processing times
 - Message completion rates

It turned out that there are several areas where data to address these measures can be obtained, but it is not easy. There is no single place and many of the sources are outside DoD.



What Data Would Support These MoM?

(Sample List)

- Coordination with non-military organizations
 - Civilian mortality rates
 - Efficiency of information exchange with NGO, PVO, ... etc.
 - School attendance rates
- Costs and resources
 - Cost of lift, forces, resources
 - Number and type of forces within theater
 - Cost of contract support (e.g., Brown and Root Services Co.)

There are data available, but they must be aggressively sought, from non-traditional sources, and require validation and management

This means that there must be an aggressive effort made to discover the data sources, and also that the data thus obtained must be in some way verified or validated for its intended use.



Weaknesses in the Analytical Infrastructure

- The major weaknesses with the analytical infrastructure in supporting our approach are
 - Data availability is opaque: who has it? How good is it?
 - Lots of intangibles in PO/HA, very difficult to quantify
 - Complexity and variety of PO/HA defy general solutions
 - Tool availability is poor, especially models
 - Multi-organizational and multi-disciplinary approach lacking
 - Parochial perspectives: service-oriented, model-oriented, department-oriented...etc.
 - Lessons learned not well documented, disseminated or useful — politicized
 - Most analytical efforts are second hand, lack actual observation in real time as a basis for analysis

The working group then assembled a list of perceived weaknesses in our analytical infrastructure to conduct such an assessment.



Recommended Investments in Analytic Infrastructure

1. Educate analysts
 - How PO/HA differ from conflict-based analysis
 - Local context (history, culture,...)
 - Lessons identified, operational experience, existence of non-conflict-based models
 - Differences among stakeholders (culture, terminology, goals...)
 - Classification barriers exclude important stakeholders
2. Change our analytical skill sets
 - Joint and Combined experiences
 - Multi-disciplinary focus (social sciences, behavioral sciences...)
 - Multi-organizational experiences (UN, World Bank, State Dept...)

The next three charts spell out the five recommended areas of improvements in analytical infrastructure which should address the weaknesses. We have to put effort into educating our analysts in the differences between analysis of the Gulf War and analysis of Bosnia operations. They need to be aware of the local context of the missions, the history and culture of the region. They have much background to assimilate before they can intelligently analyze problem areas or solutions. They need to be told that there exist such things as non-conflict based models, and who has them and how well they work.

We need to teach them that a DoD SECRET clearance requirement shuts many doors to important stakeholders who do not have one, and to be sensitive to that so those doors can remain open.

We need to develop analysts who have joint and combined experience, and interagency experience, to help solve problems in conjunction with the UN and the State Department, not just DoD solutions. Many cases will require analysts involvement with, and familiarity with, social scientists and behavioral scientists. Mathematicians and physicists have less usefulness.



Recommended Investments in Analytic Infrastructure (cont)

3. Improve data access, collection and management

- Data management techniques
- Knowledge management practices (include lessons “learned”)
- Interoperability of data collection, processing and distribution, including non-traditional sources
- Data integrity and validity
- Visibility and access of relevant data sources

4. Develop tools

- Experimentation and gaming
- Model development: Which work? Which don’t? Why not?
- Actual operations and exercises

Data still are a requirement for analysis, and these operations have unique data requirements. Relevant data must be found, analyzed, organized, verified, and in a word, managed. We also need to capture knowledge, and manage that so we can learn from our previous lessons and not repeat costly mistakes.

Tools are an area which are woefully inadequate at the moment. Our best opportunities seem to lie in the areas of gaming and experimentation. Model development has to virtually begin anew from our current stable of conflict-based models. It is clear that they generally are not applicable to these situations. It would be useful to understand exactly why and to determine if it is worthwhile to develop new ones that are applicable.

Lastly, we should never ignore the ongoing operations and exercises which can provide us with valuable representations of the real world to study.



Recommended Investments in Analytic Infrastructure (cont)

5. Conduct operations analysis during operations
 - Back to our roots (built on a foundation of basics!)
 - Analysis team on staff during crises (ex: OAT in Allied Force)
 - Multi-disciplinary, multi-organizational
 - Forms the basis of later lessons learned team
 - Integrate analysts into JTF staffs; participate in exercises
 - Educate commanders and staffs on value of analysts

We should return to our roots in operations analysis and conduct analyses during operations, for operational commanders. Analysis teams need to be created and exercised in the staffs of JTFs and CINCs during such operations, as well as in the preceding training. Arriving on the day the deployment begins with a clipboard and questionnaire is not likely to be successful. Such analytical teams when formed and trained, with a habitual association with the staff and commander, can render valuable service, and serve as a core for the lessons learned team.



Final Thought

- There is not a central champion within the analysis community for these types of operations. Given the prevalence of PO/HA operations, their importance to national policy, and the support they require, there ought to be.
- The Society can and should play a role in solving this problem.

This final point is central. There is no analytical agency or group which is the central focus for PO/HA, and there ought to be. MORS can play a role in identifying one.



**Working Group Report
WG 5 - Counterterrorism/
Weapons of Mass Destruction**

**Melissa Hathaway
Brena Starr**

The following presentation was developed by analysts participating in the CT/WMD Working Group of the Impact of C4ISR MORS conference, held in Carlisle, PA on 30 October through 2 November 2000.

In order to baseline our group, briefings were given by FEMA on Annex 13 and the Federal Emergency Response Plan, Directorate of Military Support on DOMS Support to Civil Authorities, Defense Intelligence Agency on Dragon Fury and a Threat Brief, and CMI-S on Consequence Management Information Services. Some study materials were provided by the Defense Threat Reduction Agency (DTRA).



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Objectives

- Determine how C4ISR is applied to threat detection and warning
- Determine how information can be used to support contingency planning and how C4ISR can provide you that information
- Determine the impact of C4ISR on first response and inter-government crisis C2
- Determine the impact of C4ISR on long term recovery efforts

The following objectives were provided to the working group to help focus their discussion and analytic approaches:

- Determine how C4ISR is applied to threat detection and warning.
- Determine how information can be used to support contingency planning and how C4ISR can provide you that information.
- Determine the impact of C4ISR on first response and inter-government crisis C2.
- Determine the impact of C4ISR on long term recovery efforts.



Crisis vs. Consequence

■ Crisis Management

“Measures to identify, acquire, and plan the use of resources needed to anticipate, prevent, and/or resolve a threat or act of terrorism.”

■ Consequence Management

“Measures to protect public health and safety, restore essential government services, and provide emergency relief to governments, businesses, and individuals affected by the consequences of terrorism.”

Concurrent - NOT Consecutive

When looking at the complexity of CT/WMD events, it is important to understand how the different communities think about the problem. It can be divided into two different areas that occur concurrently, not consecutively: Crisis Management and Consequence Management. The following definitions are provided to better understand the complexity of the process and problem.

Terrorism - (DoD) The calculated use of unlawful violence or threat of unlawful violence to inculcate fear; intended to coerce or to intimidate governments or societies in the pursuit of goals that are generally political, religious or ideological. [JP 1-02]

Weapons of Mass Destruction: Title 18, U.S.C. 2332a: (1) any destructive device as defined in section 921 of this title, [which reads] any explosive, incendiary, or poison gas, bomb, grenade, rocket having a propellant charge of more than four ounces, missile having an explosive or incendiary charge of more than one-quarter ounce, mine or device similar to the above; (2) poison gas; (3) any weapon involving a disease organism; or (4) any weapon that is designed to release radiation or radioactivity at a level dangerous to human life. [Title 18, USC 2332a]

DoD: In arms control usage, weapons that are capable of a high order of destruction and/or of being used in such a manner as to destroy large numbers of people. Can be nuclear, chemical, biological, and radiological weapons, but excludes the means of transporting or propelling the weapon where such means is a separable and divisible part of the weapon. Also called WMD. [JP 1-02]

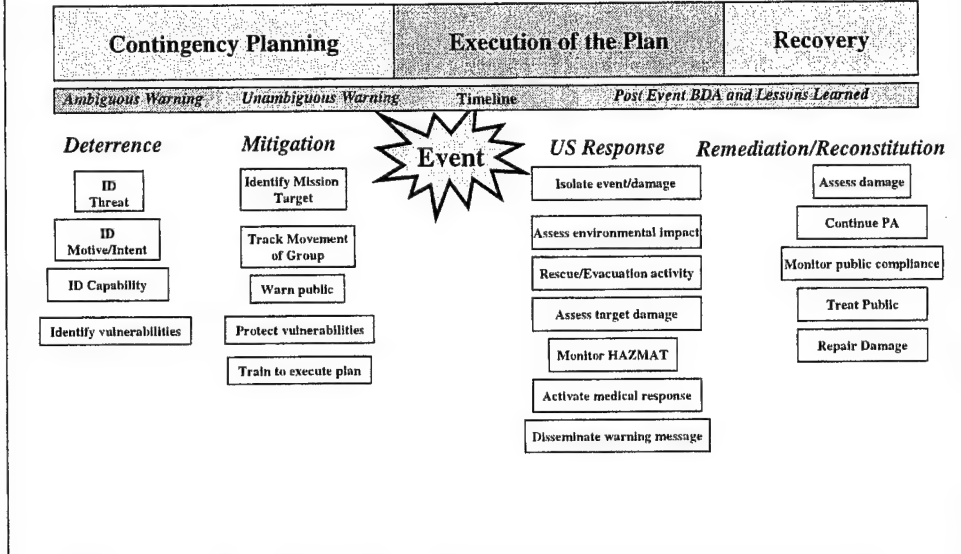
Six categories of WMD include chemical, biological, nuclear, radiological, conventional high explosives, and industrial chemicals (toxins).

Crisis Management: Measures to identify, acquire, and plan the use of resources needed to anticipate, prevent, and/or resolve a threat or act of terrorism

Consequence Management: Measures to protect public health and safety, restore essential government services, and provide emergency relief to governments, businesses, and individuals affected by the consequences of terrorism.



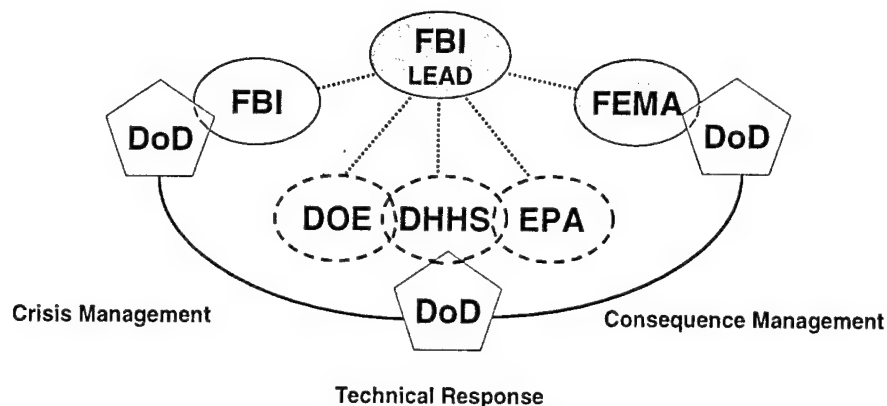
Decision Timeline



In order to fully analyze how C4ISR can better support mission effectiveness of CT/WMD, it is important to understand the process by which a CT/WMD event unfolds. The figure above was used to outline the discussion and focus the analytic approaches toward the study objectives.



Sharing Resources



AND COUNTLESS OTHERS
(more than 30 other agencies)

There are many players involved in the CT/WMD mission area. The most important fact to consider is that DoD is not the lead agency. If the event occurs internationally, the Department of State will be the lead agency and DoD will be the supporting agency. If the event occurs within any part of the United States and its territories, the Federal Bureau of Investigation (FBI) (Department of Justice) will take the lead during crisis management and then hand-off all response and recovery operations to the Federal Emergency Management Agency (FEMA). Again, DoD and its capabilities (information, assets, resources) are supporting the lead agency.

Finally, it is important to recognize that there are countless other agencies involved in the efforts of crisis and consequence management. The number and complexity of which agencies are information consumers and not providers are scenario dependent.



Crisis Management

The first part of our analytic approach focused on crisis management



Key Questions

- What do I need to do to prevent, interdict, deny, destroy the event/capability?
- Who has the capability?
- What do I need to counter the capability once known?

When developing our approach to studying crisis management, the working group determined that there were key questions the decision maker would ask in the crisis management phase:

- What do I need to do to prevent, interdict, deny and/or destroy the event or capability?
- Who has the capability? Which terrorist groups? Which countries?
- What do I need to counter the capability once known?



CT/WMD Deficiencies and Amelioration

- **Deficiency: Information righteousness (too much, trust, territorial)**
 - Fusion, need a way to establish a common operational picture
 - Increase interoperability; smart agents and search engines
- **Deficiency: Lack of framework for analysis**
 - Business process model
 - Human factors analysis (intent, CONOPs)
 - More/well placed/trained HUMINT
 - Bayesian predictive analysis to help establish threshold criteria

The following discussion outlines some of the deficiencies (hindrances to achieving quality analysis of the problem) that the working group identified and possible methods to ameliorate them.

The first deficiency was what we call "information righteousness" which refers to the overall nature of the stakeholders and their approach to each other in the area of information. Whose information or source of data do you trust? What determines how that information is going to be shared among and between the different organizations (territorial issues)? In addition, it was discussed that some of the systems are stove-piped (collection methods, interoperability issues, etc). To ameliorate this there needs to be fusion of data. Analysts need a mechanism to establish a common operational picture. In addition, the community (all the stakeholders) needs a mechanism to increase inter-operability and the sharing and obtaining of data from the disparate data sources — such as smart agents and smart search engines.

Another deficiency is the lack of framework for analysis which refers to establishing the framework to analyze and "bin" all of the data an [intelligence] analyst must sort through. This includes, but is not limited to, sources of funding of a WMD program or terrorist organization, intent/agenda of the adversary, CONOPs of the adversary, 3rd party relations, etc. This deficiency could be ameliorated by developing a business process model to help the analyst understand the business practices and information required to support a CT/WMD operation. A human factors model or technique could help an analyst better understand the psyche of the adversary (e.g., intent, agenda, CONOPs). Well placed and trained HUMINT sources could help provide more accurate data to an analyst, thus providing a better framework for analysis. Finally, a Bayesian predictive analysis approach could be used to help establish threshold criteria and correlate data into sets of information that is easier for an analyst to determine whether a country is developing a WMD program or a terrorist group intends to employ a WMD capability.



CT/WMD Deficiencies and Amelioration

- Deficiency: Lack of data accessibility
 - Increase sharing of data
 - Training of personnel
 - Reduce classification of data to increase dissemination
- Deficiency: *Posse comitatus*
 - Continue exercise program through National Defense Program Office
 - Increase liaison officers between Federal, DoD and IC
 - Increase public awareness (deterrence mechanism)

Lack of data accessibility is also a deficiency. Is there priority in collection and feedback to cue other assets. What about the issue of warnings? These analytic deficiencies could be ameliorated by increased sharing of data (interoperability), training of personnel to know what to look for/ask for, and through the reduction of classification of data to the lowest level to increase dissemination to a larger audience.

The US Constitution causes some deficiencies in our analysis because of *posse comitatus* which limits the Intelligence Community's (IC) and DoD's ability to collect information on US citizens. To ameliorate this, the working group recommended continuing exercise programs through the National Defense Program Office to help law enforcement and DoD/IC communities understand each other's missions and data resources. In addition, increasing the liaison officers (LNOs) within Federal/IC/DoD communities would also lead to increased information sharing and better understanding of mission areas. Another way to enable information sharing across DoD/IC and law enforcement would be to inform/make visible to the public a pending threat. This could be used as a deterrence mechanism to the adversary because the public is more aware/educated on situational awareness (what to look for) and the importance of established security procedures.



CT/WMD Impact of Improvements

- Increased available amount of information to the decision maker
- Better understanding of the threat
- Increased threat warning capabilities
- Improved ability to plan for contingencies
- Decreased dissemination time of data to decision maker
- Increased confidence of data
- Possible deterrence mechanism

The results of our actions would lead toward measures of effectiveness or improvements in the following areas:

- Increased amount of available information to the decision maker.
- A better understanding of the threat.
- Increased threat warning capabilities which would ultimately reduce the number of terrorist/WMD events.

Other impacts include:

- Improved ability to plan for contingencies.
- Decreased dissemination time of data to the decision maker.
- Increased confidence in the data.
- A possible deterrence mechanism.



Measures of Merit

- In the conduct of this mission the means by which we measure ultimate success is:
 - Never have a WMD event
- Secondary measures which provide insight into our ability to conduct this mission at the macro level are:
 - Number of events prevented
 - Number of days without an event
 - Number of WMD programs cancelled/thwarted
 - Number of terrorists captured/denied

Ultimate success of a program to develop counterterrorism defenses against the use of WMD would be that the United States would never experience or have to face a WMD event. The working group did not believe this to be a realistic measure, therefore, it developed secondary measures of success that include:

- Number of events prevented.
- Number of days without an event.
- Number of WMD programs cancelled or thwarted due to better analytic techniques, collection priorities, trained HUMINT.
- Number of terrorists captured/denied.



CT/WMD Analytic Method

- Wargaming
 - Understand organizational barriers
 - Determine timeliness and quality of decisions
- Delphi model
 - Determine true information requirements
 - Capture SME insight
- Business process model
- Bayesian model
 - Establish framework to better understand criteria (probability of an event/capability)
- Compare data to live exercises

Our Analytic Method would be utilized through wargaming, to understand the organizational barriers and to determine the timeliness and quality of decisions; a Delphi model, to determine true information requirements and to capture the subject matter expert insight; the business process model to better understand information flows; the Bayesian model, to establish the framework to better understand criteria such as the probability of an event is going to occur or capability is in development or deployment; and to compare and validate data with the results of live exercises.



CT/WMD Scenario/ Data

■ Scenarios

- Known threat, International, Tier 1
- Not well known threat
- CONUS militia

■ Performance data

- Based on wargaming, live exercises and models

■ Threat data

- Dragon Fury database (OCONUS)
- FBI National Security Division (CONUS)

WMD	CONUS	OCONUS
Chemical		
Biological		
Nuclear		
Radiological		
High Explosive		
Other Chemicals		

Three primary scenarios should be addressed. The first is a known threat such as an international group within a Tier 1 country (Iran, Libya, etc). This would test how the tools work using the best available data. If it is a Tier 1 country, there should be a significant amount of intelligence available to the analytic community. The second scenario should consider a less known threat to determine how the analytic community and models deal with less data and understanding regarding the threat. Finally, a CONUS militia scenario should also be addressed to account for the involvement of the FBI intelligence resources and the information requirements in a domestic scenario.

In addition to these three primary scenarios, it will be important to develop a run matrix of all of the potential scenarios to include all of the WMD elements: Chemical, biological, radiological, nuclear, high explosive and industrial chemical. In addition, scenarios should address whether the event occurs in CONUS or OCONUS, whether multiple agents were used and targets attacked, and if the event were covert or overt in nature.

Performance data would be based on wargaming, live exercises and models.

Threat data would be obtained from such sources as DIA's Dragon Fury database for international threats and the FBI's National Security Division for US citizen based threats.



CT/WMD Assumptions

- All stakeholders will play
- Only current US systems/capabilities will be evaluated
- DoD is not the lead agency (fact)
- No foreign assistance
- Money is not an issue

Within the workgroup, some assumptions were necessary to narrow the scope of our approach. We assumed that all stakeholders would play — which is a very large assumption. Also, that only current US systems/capabilities will be evaluated. DoD is not in the lead — which is more of a fact rather than assumptions since DoD will always play a supporting role.

Other assumptions included not receiving foreign assistance and that money would not be an issue.



CT/WMD Weaknesses of Approach

- Approach relies upon cooperation among/between stakeholders
- Relies on ability to understand motive, intent and culture of adversary (counter culture to US)
- Money/manpower constraints to enable analysis or ensure participation

The weaknesses of our approach is that the approach relies upon the cooperation among and between the more than 30 stakeholders involved. It relies on the ability to understand motive, intent and the culture of the adversary (especially one that is a counter culture to the US), and that the funding and manpower constraints would enable analysis or ensure participation.



CT/WMD Resultant Risk in Answer

- Faulty results on timeliness, quantity of data
- May not gain understanding of the motive and behavior of the adversary but will gain some insights in capability
- Negative impact on extent of cooperation
 - Increased information righteousness

The resultant risk in the answer is that analysis could provide faulty results on timeliness and the quantity of data required to support an operation. The analysis also may not help the community gain an understanding of the motive and behavior of the adversary but will help gain some insights in capability (who has it and what is it). Finally, the analysis approach may result in a negative impact on the extent of cooperation among and between the organizations which may increase "information righteousness." For example, one organization may be seen as withholding data and thus labeled as "not a team player."



Consequence Management

The second part of our analytic approach focused on consequence management.

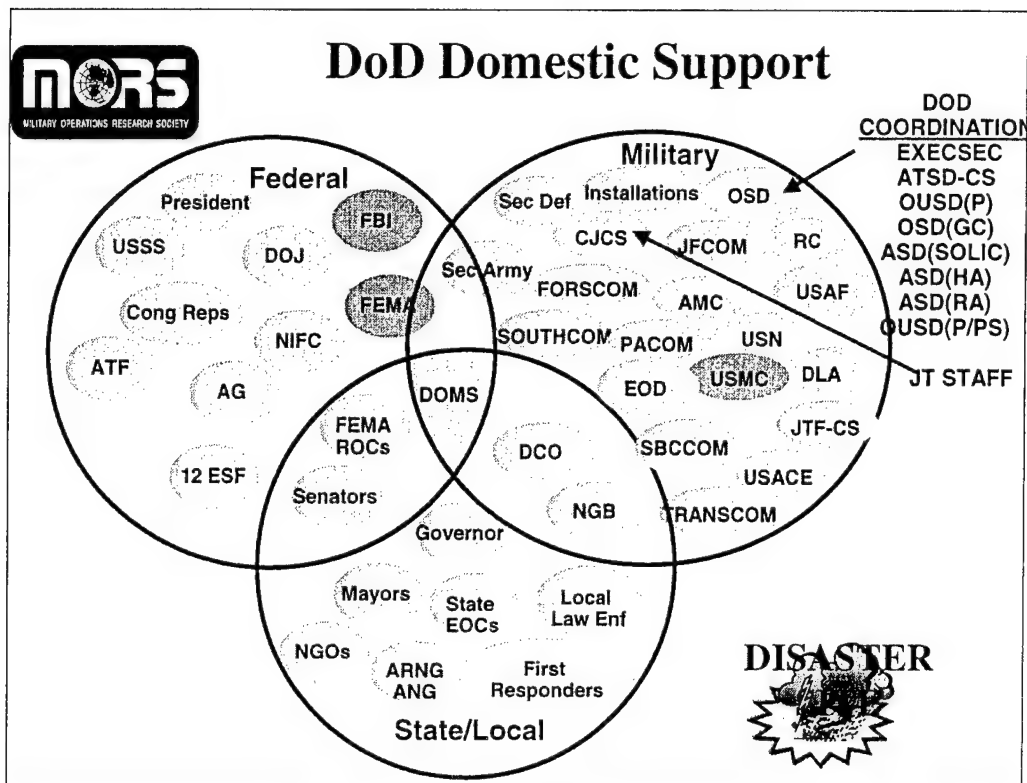


Key Questions

- What do I need to do to limit the event - the damage, death toll, spread?
- How can I decrease response time?
- How can I decrease recovery time?

When developing our approach to studying consequence management, the working group determined that there were key questions that the decision maker would ask in the consequence management phase:

- What do I need to do to limit the damage, casualties, fatalities and spread of the event?
- How can I decrease response time?
- How can I decrease recovery time?



There are many players involved in the CT/WMD mission area. This diagram reiterates the complexity in ensuring proper coordination among and between the players. It is also used to outline DoD's supporting role.

The number and complexity of which organizations are information consumers and not providers are scenario dependent.



CT/WMD Deficiencies and Amelioration

- Deficiency: Lack of predictability in scenario and weapon
 - Create robust database of scenarios
 - Based on most likely CONOPs
 - Develop understanding of constant variables vice dynamic
 - Develop understanding of Blue capabilities and CONOPs at the tactical, operational and strategic
 - Develop adequate representation of environment (weather and infrastructure)
- Deficiency: Potential size, complexity of C4ISR to support 1st response and long term recovery
 - Need to understand (functions, interoperability and scope) how a C4ISR system supports local, state, federal
 - Not inhibited by classification

Some of the deficiencies in the area of consequence management is the lack of predictability in any scenario and weapon. To ameliorate this hindrance the working group determined that a robust database of scenarios should be created. It should include the most likely concept of operations the adversary will employ. There is also a need to develop an understanding of the constant variables vice dynamic variables. In addition, a better understanding of Blue capabilities and CONOPs at the tactical/local, operational/state and strategic/Federal level needs to be developed. Finally, an adequate representation of the environment such as weather and infrastructure needs to be developed.

The second deficiency the working group identified was the potential size and complexity of C4ISR to support first response and long term recovery efforts. To ameliorate this, there is a need to understand functions, interoperability and scope of how a C4ISR system supports local, state and federal personnel. This support should not be inhibited by classification of information.



CT/WMD Deficiencies and Amelioration

- Deficiency: Data availability
 - Large amount of data exists outside of DoD
 - Obtain understanding of information that are outside of DoD
 - Identify methods to access that data (MOA/U)
- Deficiency: Understanding of human behavior under stress
 - Fund study to better understand human behavior
 - Collect data on previous research
 - Live experiments
 - Analyze previous incidents

Data availability is the third deficiency. Large amounts of this data exist outside of DoD. We must obtain a better understanding of information that is outside of DoD and we should identify methods to access that data through MOA/Us.

The understanding of human behavior under stress is also a deficiency which could be ameliorated by funding a study to better understand human behavior. This could be accomplished by the collection of data from previous research, live experiments and analysis of previous incidents.



CT/WMD Deficiencies and Amelioration

- Deficiency: Tool availability
 - Complex Adaptive System (CAS)
 - Δt (improvements and differences in process)
 - Quality of information
 - Test sensitivity of variables
 - Allows analyst to understand architecture

Finally, tool availability is a deficiency in the current analysis ability of the community. Although it would be useful to conduct a study to understand what tools are in fact available to the community, the working group determined that exploring the use of CAS to analyze these mission areas would result in useful information. CAS allows the analyst to look at the variable and metric of time. It allows the analyst to address how much time is gained or lost based on differences in architectures and scenarios. It also allows the analyst to evaluate improvements and deficiencies in the processes explored. It allows you to examine the quality of information, and how that might affect the overall system or time it takes to move information through the system. It also allows the analyst to explore and "test" the sensitivity of variables based on scenario, architecture, etc. Finally, it provides a learning environment for the analyst and decision maker to facilitate understanding of the architecture and overall process of these mission areas.



CT/WMD Impact of Improvements

- Gained insight and understanding of impact of events on infrastructure
 - People and C2 Requirements
- Identified points of failure in system
- Increased COAs available to decision maker
- Increased credibility of analysis
- Improved response, recovery time
- Improved connectivity
- Reduced casualties
- Improved containment

The results of our actions would lead toward measures of effectiveness or improvements in the following areas:

- Gained insight and understanding of the impact of events on the infrastructure including people needed and C2 requirements.
- Identified points of failure in the system.
- Increased coarse of actions and options available to the decision maker.
- Increased credibility of analysis because of the models and analysis employed.
- Improved response and recovery time.
- Improved connectivity among and between the many stakeholders.
- Reduced casualties and fatalities.
- Improved containment of the area.



Measures of Merit

- In the conduct of this mission the means by which we measure ultimate success is:
 - Minimize number of lives lost
 - Minimize area damaged
 - Minimize resources required to respond and recover

The means by which our working group decided that the decision maker would measure ultimate success is:

- Reduce the number of casualties and fatalities.
- Minimize area of damage.
- Minimize resources required to respond and recover from an event.



CT/WMD Analytic Method

- M&S
 - Collection models to understand environmental impacts
 - Optimization (C2, information)
 - Nodal analysis
 - Lethality
 - Master timeline curves
- Conduct functional exercises
 - Understand time to respond
 - Information requirements
 - Infrastructure requirement

The Analytic Method for CT/WMD in the area of consequence management focused on the use of models and simulations. There were several models nominated to support the analysis. These included:

- Collection models to understand collection requirements, information support requirements and environmental impacts.
- Optimization models to better understand the command and control and information flows.
- Nodal analysis to better understand the number and complexity, throughout requirements and single points of failure within the supporting infrastructure.
- Lethality and ground effects models to better understand the impact of the weapon used to include the extent damage caused by the use of the weapon.
- Master timeline curves (DTRA) to understand the casualties, fatalities, area coverage and long term recovery requirements.

Functional exercises would also be conducted as part of the analytic method to understand the time to respond to an event, information requirements and supporting infrastructure requirements.



CT/WMD Scenario/ Data

■ Scenarios

- Multiple events/agents, CONUS
- Multiple events/agents, OCONUS

■ Performance data

- Live exercises
- Models
- Past events

■ Threat data

- Models (effects/spread)
- Dragon Fury-OCONUS/FBI-CONUS (terrorist and delivery agent)
- DTRA (C, R, N)
- CDC (B)
- SBCCOM (C, B)
- DOE (HE, N, R)
- Local (HE)

WMD	CONUS	OCONUS
Chemical		
Biological		
Nuclear		
Radiological		
High Explosive		
Other Chemicals		

N: Nuclear
B: Biological
C: Chemical
R: Radiological
HE: High Explosive

Two primary scenarios should be addressed in the consequence management phase of the analysis. Both are worst case scenarios that would evaluate multiple targets or events with the use of multiple types of WMD in CONUS and OCONUS.

In addition to these two primary scenarios, it will be important to develop a run matrix of all of the potential scenarios to include all of the WMD elements, chemical, biological, radiological, nuclear, high explosive and industrial chemical. In addition, scenarios should address whether the event occurs in CONUS or OCONUS, whether multiple agents were used and targets attacked, and if the event were covert or overt in nature.

Performance data would be based on live exercises, models and past events.

The threat data would be received through models to determine effects and the spread of agent, DIA's Dragon Fury database for an OCONUS event and FBI's National Security Division for terrorist and delivery agent data in a CONUS event. Threat data could also come from DTRA in the case of chemical, radiological and nuclear; CDC if biological; SBCCOM if chemical or biological; Department of the Energy if high explosive, nuclear or radiological; and local sources if involving high explosives.



CT/WMD Assumptions

- Only current US systems/capabilities will be evaluated
- DoD is not the lead agency (fact)
- No foreign assistance
- All stakeholders will play
- Money is not an issue
- Assume accurate depiction of data in models
 - Limited real world data to understand/validate effects

Within the workgroup, some assumptions were necessary. We assumed that all stakeholders would cooperate and share data to support the analysis. This is a significant assumption. Also, that only current US systems/capabilities will be evaluated. Another assumption included that DoD is not in the lead — which is more of a fact rather than an assumption since DoD will always play a supporting role.

Other assumptions included not receiving foreign assistance and that money will not inhibit our analysis or ability to exercise the inter-agency participants, coordinate, share data.

The only addition to the list of assumptions that also applied to crisis management was the assumption that the models are accurately portraying the effects of WMD events. Since there is limited real world data to understand and validate effects, this may be a significant assumption.



CT/WMD Weaknesses of Approach

- Relies on cooperation and coordination amongst all stakeholders
- Difficult to validate results based on lack of real data/understanding of Chemical, Biological, Nuclear, Radiological, High Explosive (CBNRHE) use
 - Limited data

The weaknesses of our approach is that it relies upon the cooperation among and between the more than 30 stakeholders involved. More importantly, the working group's approach relies on data and results of models that have not been compared to, or use real-world data. There is limited data available on actual WMD incidents. Albeit there is some including the sarin gas attack in Japan, the nuclear melt-down at Chernobyl, and the multitude of high explosive attacks in Great Britain and the few in the United States (i.e., Oklahoma City and World Trade Center), there is not a wide variety of real-world data or multiple examples.



CT/WMD Resultant Risk in Answer

- May not provide accurate depiction/data on:
 - Casualties and fatalities
 - Damage
 - Environmental impact
- Poor input data will provide incorrect recommendation on optimization, C2 requirements, etc.

The resultant risk in the answer is that analysis could provide faulty results on the number of casualties and fatalities that would result from an event; the extent of damage caused by the WMD employed, and probable environmental impact.

Another risk is that due to the lack of real-world data of WMD events as stated in the weaknesses of our approach, by using faulty or poor data we could provide incorrect recommendations to the decision makers on how to optimize the architecture and information flows, what C2 requirements and nodes should be established. These risks may be significant.



CT/WMD Investments in Analytic Infrastructure

- Increase exercises that involve all stakeholders
- Develop data warehousing and smart agents to increase flow of information to all levels
- Develop models
 - To understand information flow (optimize)
 - To create framework to understand the adversary
 - To establish criteria to predict the event
- Investigate applicability of CAS

Based on the analysis approach in both crisis and consequence management areas, the working group believed that the following investments would be required to further the analytic community.

- Increase the number of exercises that involve all of the stakeholders. Although there are some exercises currently taking place (e.g., TOP OFF), more resources need to be dedicated toward this. This would result in a better understanding of the information requirements, C2 requirements, information flows, timeliness of information flows, response operations, recovery operations, etc. It would also assist the different stakeholders in understanding what each one brings to the table (information, assets, etc).
- Develop data warehousing capabilities and smart agents to increase the flow of information to all levels. Part of the problem is that information is held in many locations across tactical (local), operational (state) and strategic (federal) levels. In addition, there is information available in academia, the laboratory community as well as other resources. We need to establish a mechanism to assist the information flow to all levels — the decision makers at the National Command Authority (NCA) — as well as the decision makers who are dealing with the incident.
- Investigate the applicability of using CAS. It will be important to determine whether CAS can really assist in understanding the architecture, information gain/lost by configuring systems and nodes in a particular way, and complexity of the scenarios.



CT/WMD Investments in Analytic Infrastructure

- Conduct research to evaluate/understand existing studies, models, data, theories
- Identify specific areas of M&S/analytic tools where gaps in capabilities exist
 - Act to extend/develop technology to address gaps
- Identify existing or develop MOA/U with other agencies
 - To obtain data
 - To understand requirements under FRP
- Conduct requirements analysis

Based on the analysis approach in both crisis and consequence management areas, the working group believed that these additional investments would be required to further the analytic community.

- Conduct research to evaluate and understand existing studies, models, data and theories in all areas, but especially human factors. This study of studies will allow analysts to understand lessons learned, data sources, alternative scenarios and possible theories to assist in model formulation.
- Identify specific areas of models, simulations, and analytical tools where there are gaps in capabilities and act to extend or develop the technology to address those gaps.
- Identify existing or develop Memoranda of Agreement or Understanding (MOA/Us) with other agencies. There must be data in order to conduct analyses. Sometimes this can only be achieved by establishing an MOA/U. In addition, these agreements will help analysts understand the requirements as established under the Federal Response Plan (FRP). These requirements include, C2 structure, materiel requirements, information flows/needs, decision timelines, etc.
- Finally, the analytic community would benefit from a comprehensive requirements analysis. Requirements of all levels and stakeholders need to be better understood.



CT/WMD Investment Payoff

- Quantify C4ISR contribution to the CT/WMD mission areas

If the previous investments were made, an analyst could begin to demonstrate where C4ISR contributes to the mission success of countering WMD and countering terrorism. The investments would allow one to quantify where the improvements could support early warning, contingency planning, first responders and their required command and control, and long term recovery efforts.



Synthesis Panel

Dr. Stuart Starr, FS

This brief contains the report of the Synthesis Panel for the MORS Workshop "Advancing C4ISR Assessment," conducted at the Army War College, Carlisle, PA from 30 October - 2 November 2000.



Synthesis WG Participants

■ Dr. Stuart Starr, FS, Chair	MITRE
■ Mr. Dean Free	Consultant (MTW)
■ Col Jack Jackson	IDA/JAWP (CT/WMD)
■ Mr. Joe Jennings	MITRE (Coercion)
■ Prof. Bill Kemple	NPS (Peace Operations)
■ Dr. Jerry Kotchka	LMCO (MTW)
■ Col Jose Negron	USAF (Peace Operations)
■ Mr. Robie Samanta-Roy	IDA (MTW)
■ Mr. Jim Schoening	CECOM (Urban Warfare)
■ Dr. Dave Signori	RAND (Floater)
■ Mr. Chuck Taylor	OSD (CT/WMD)
■ LTC Pat Vye	USA (Urban Warfare)
■ Dr. Larry Wiener	Navy (Coercion)

As illustrated in the slide, the Synthesis Panel for this workshop was unusually large. That was because it was decided to have at least two individuals monitor each of the five mission-oriented panels. They included:

- Major Theater War (Free, Kotchka, Samanta-Roy)
- Urban Warfare (Schoening, Vye)
- Peace Operations (Kemple, Negron)
- Coercion (Jennings, Wiener)
- Counter Terrorism/Weapons of Mass Destruction (Jackson, Taylor)

An effort was made to have the distribution of organizations represented on the Synthesis Panel reflect the broad make-up of MORS. Thus, the following representation was provided:

- Services -- 5
- FFRDCs -- 4
- Private industry -- 2
- OSD -- 1
- Academia -- 1



Agenda

- Panel goals, composition, plan of attack
- Insights on nature of the problem
- Preliminary plan of action
- Summary

The Synthesis Panel report consists of four sections.

As a context, the first section identifies the goals and scope of the Synthesis Panel, the composition of the Synthesis Panel, and the plan of attack that the Panel adopted.

The second section summarizes insights on the nature of the problem that the Synthesis Panel derived. These insights were developed from the remarks of the plenary speakers, the presentations during the tutorial session that preceded the workshop, the presentations by the luncheon speakers, and the deliberations of the five, mission-oriented panels.

The third section formulates a preliminary plan of action for the community to address the shortfalls in C4ISR assessment identified during the workshop.

The final section briefly summarizes the major findings and conclusions of the Synthesis Panel.



Panel Goals, Scope

■ Goals

- Develop a better understanding of the C4ISR assessment problem, from a holistic perspective
- Generate a synthesized, preliminary *plan of action* to redress major shortfalls in C4ISR assessment

■ Scope

- Consider C4ISR assessment from *multiple* perspectives; e.g.,
 - Support to investment strategy development
 - Support to operations
- The preliminary plan of action is *not* resource constrained

The Synthesis Panel had two major goals. First, it sought to develop a better understanding of the C4ISR assessment problem. In contrast to the other panels, it adopted a holistic perspective, integrating across the views of the five individual mission areas. Second, it sought to generate a synthesized, preliminary plan of action to redress the major shortfalls identified in C4ISR assessment. This product will then be used by the Joint C4ISR Decision Support Center (DSC) to develop a more detailed plan of action.

During the plenary session, RADM Nutwell indicated his interest in performing C4ISR assessments to support investment strategy development. However, due to the immaturity of several of the mission areas of interest (e.g., coercion, counter-terrorism), it was decided to expand the scope to consider C4ISR assessment support to operations, as well. Finally, it must be emphasized that the preliminary plan of action developed by the Synthesis Panel is *not* resource constrained. It is anticipated that those constraints will be factored into the final plan of action that will be generated by the DSC.



Plan of Attack

- Participate in the deliberations of each Panel
 - Capture "Blinding Flashes of the Obvious" ("BFOOs")
 - Perform "SWOT" analyses
 - Identify candidate actions (e.g., stop, start, continue, modify)
- Synthesize the individual "SWOT" analyses into a composite assessment
- Generate a plan of action
 - Formulate a framework
 - Embed actions into the framework
 - Prioritize and expand upon recommended actions

The Synthesis Panel employed the following plan of attack. The individuals assigned to the five mission-oriented panels participated in their deliberations. They were asked to capture any insights developed by those panels (e.g., "BFOOs"); to perform "Strengths, Weaknesses, Opportunities, Threats/constraints (SWOT)" analyses of the C4ISR assessment capability in those mission areas; and to identify candidate actions (e.g., stop, start, continue, modify) to redress perceived C4ISR assessment shortfalls.

Drawing on the individual SWOT analyses, the Synthesis Panel would then develop a composite assessment. Using this as a point of departure, a preliminary plan of action would be developed. As a context for the plan, an appropriate planning framework would be developed. The candidate actions would then be embedded in this framework. It was left to the DSC to prioritize and expand upon the recommended actions.

It has often been noted that "no plan survives contact with the enemy." Similarly, the Synthesis plan of attack was adjusted in near-real-time to reflect the realities and constraints of the workshop. Thus, the individual SWOT analyses were performed informally and the synthesized SWOT perspective was developed on napkins over a panel dinner. However, the actions of the panel were consistent with the spirit of the overall plan. The results of those deliberations are summarized in the Synthesis Panel outbrief.



Agenda

- Panel goals, composition, plan of attack
- Insights on nature of the problem
- Preliminary plan of action
- Summary

The Synthesis Panel developed insights on the nature of the C4ISR problem by taking advantage of several sources. This section briefly summarizes those findings in the following areas:

- Broad insights developed by the Synthesis Panel through its panel deliberations. The Panel observed that with the conclusion of the Cold War, a new DoD context is emerging. Within this context, new assessment challenges are emerging for the analyst. Based on these new challenges, a new agenda is emerging for C4ISR assessment.
- Insights acquired through the presentations at the tutorial session. To provide a common understanding of the state-of-the-practice in C4ISR assessment tools and approaches, two tutorial tracks were conducted: selected M&S and more “unorthodox” approaches (e.g., influence diagrams, complex adaptive systems). There are several cross-cutting insights that emerge from those tutorials.
- Ideas presented during the luncheon briefings. The luncheon presentations provided historical perspectives on warfare over a 2000 year period: the Mongol hordes, the Battle of Gettysburg and the air war over Serbia. Several consistent insights emerged from these disparate operations.
- Insights acquired and captured in the individual mission-oriented panel discussions. The Synthesis Panel assembled several insights (“Blinding Flashes of the Obvious”) that were identified in one or more of these panels.



A New DoD Context (1 of 2)

Old



New

- | | |
|------------------------------------|-----------------------------------|
| ■ Well understood threat | ■ New and uncertain threats |
| ■ Established scenarios/operations | ■ Broad range of missions |
| ■ DoD focus | ■ National, coalition perspective |
| ■ Evolutionary capability | ■ Revolutionary capability |
| ■ Overwhelming force | ■ Info/effects-based outcome |
| ■ System-on-system advantage | ■ System-of-systems advantage |
| ■ Well defined requirements | ■ Exploration/learning |

Today's analysts find themselves in a new national security context. This slide highlights some of the dramatic shifts that have occurred since the end of the Cold War. Having the Soviet Union as the single dominant adversary over a protracted period provided a sustained focus for intelligence gatherers and force planners so that they could refine US understanding of many aspects of Soviet capability and behavior. This is in stark contrast to the "New World Disorder" in which a broad range of varied and uncertain threats have made it difficult to anticipate issues and focus intelligence resources appropriately.

As a consequence of the Soviet focus, a relatively few scenarios and types of operations were sufficient for assessment and planning. Today the US is faced with a broad set of operations and missions that include peace keeping, coercive operations, anti-terrorism, Small-Scale Contingencies (SSC) and major theater conflicts.

With the exception of the NATO allies, DoD was mainly concerned with operations that involved only the four Services. Many operations today require a much larger contingent of participants, including numerous non-NATO allies, various national government organizations, international organizations and Non-Governmental Organizations (NGOs).

Until now, war fighting capability has evolved incrementally with the addition of each new weapon system. However, information technology and precision weaponry has the potential of changing the nature of warfare in revolutionary ways.



A New DoD Context (2 of 2)

Old



New

- | | |
|------------------------------------|-----------------------------------|
| ■ Well understood threat | ■ New and uncertain threats |
| ■ Established scenarios/operations | ■ Broad range of missions |
| ■ DoD focus | ■ National, coalition perspective |
| ■ Evolutionary capability | ■ Revolutionary capability |
| ■ Overwhelming force | ■ Info/effects-based outcome |
| ■ System-on-system advantage | ■ System-of-systems advantage |
| ■ Well defined requirements | ■ Exploration/learning |

In the past, the key to success was believed to be determined by who could bring to bear overwhelming force. Today, the goal is becoming one of exploiting information about US adversaries to apply the minimum force in order to achieve a specific effect, consistent with national policy.

Advantage was often measured in platform-centric terms (e.g., who had the best tank, ship or plane). Today, when the sensors, C2 and weapons are networked together in a system-of-systems, they promise significant advantage through increased agility and discriminate application.

Finally, the stable, evolutionary environment in which requirements are relatively well understood have given way to a period of experimentation and learning necessary to understand how to exploit rapidly emerging technologies and new concepts in order to maintain a competitive advantage. Taken together, these shifts add up to a fundamentally different national security context within which today's analysts must function.



New DoD Assessment Challenges

Old



New

- | | |
|--------------------------------------|--------------------------------|
| ■ Threat based planning | ■ Capability based planning |
| ■ Refining established notions | ■ Exploring new possibilities |
| ■ Benefits of new capabilities | ■ Understanding fundamentals |
| ■ Assessing force structure | ■ Mission capability packages* |
| ■ Collection of <i>ad hoc</i> issues | ■ Hierarchy of related issues |
| ■ Tractable focus | ■ Exploding complexity |

*e.g., DOTML-PF

Shifts in the national security context have resulted in major changes in the challenges faced by analysts who are attempting to assess military capabilities, particularly C4ISR capabilities which play a critical role in force transformation and new war fighting concepts. Some of the key changes are highlighted in this slide.

In the old context, analysts could focus on means of countering a specific threat. Today they must address capabilities that can be used in an agile manner to deal with a range of threats. Similarly, because of the stability of the threat and the evolutionary nature of military capability, analysts used to refine established operational concepts and capabilities. This contrasts with the current challenge where analysts must explore completely new war fighting concepts like distributed C2 for the nonlinear battlespace.

In the past, analysts could focus on the benefits of adding a new weapon system to the force mix. Today, they must understand the fundamentals associated with networking the force or sharing information through a common operational picture. In addition, assessments used to be focused on force mix/structure issues. Today, assessments must address new mission capability packages, including all the dimensions of Doctrine, Organization, Tactics, Materiel, Leadership, Personnel and Forces (DOTML-PF).

Previously, analytical capability was often focused on *ad hoc* issues that arose in the budget process. Today there is a need for a systematic multi-level assessment of a comprehensive set of related issues. Finally, the expanded dimensionality reflected in the above factors combined with the increase in the number of players translates into significant growth in problem complexity.



C4ISR Assessment Implications: A New Agenda

- Evolve from the NATO Code of Best Practice (COBP) towards a more comprehensive *analytical construct*, requiring
 - Characterization of new missions
 - Metrics/methods for effects based outcome
 - Representations of soft factors (e.g., reason, belief)
- New *assessment capabilities*
 - Data for new dimensions
 - Training/education
 - Mix of new tools (including collaborative environments)
- New *processes*: Coupling to
 - New participants
 - Mission assessment
 - Experimentation

The changes in DoD's context and associated assessment challenges have profound implications for the C4ISR assessment community. As indicated in this slide, a new agenda is needed with improvements in three areas: A more comprehensive analytical construct, new assessment capabilities and a new culture/process for assessment. The highlights for each are discussed below.

More Comprehensive Analytical Construct. The NATO Code of Best Practice (COBP) is a good starting point for describing how to conduct a C4ISR assessment. However, DoD must extend this guidance in a number of important ways. New missions such as peacekeeping, counterterrorism and coercive operations need to be characterized in terms of scenarios, operational concepts, command and control decisions and information needs. In addition, a hierarchy of metrics and methods must be developed for measuring the impact of information superiority on effects-based operational outcomes. Finally, soft factors such as cognitive decision making, based on both reason and belief, must be better represented in our assessments.



C4ISR Assessment Implications: A New Agenda (Concluded)

- Evolve from the NATO Code of Best Practice (COBP) towards a more comprehensive *analytical construct*, requiring

- Characterization of new missions
- Metrics/methods for effects based outcome
- Representations of soft factors (e.g., reason, belief)



- New *assessment capabilities*

- Data for new dimensions
- Training/education
- Mix of new tools (including collaborative environments)

- New *processes*: Coupling to

- New participants
- Mission assessment
- Experimentation

New Assessment Capabilities. DoD will need to develop fundamentally new assessment capabilities. This will require the systematic collection of data for various aspects of new systems and concepts associated with C4ISR, information superiority and mission capability packages. At the same time, a new generation of analysts will have to be educated and trained to address the new challenges identified earlier. A mix of new tools, including information-sensitive modeling and simulation (e.g., agent based simulations) and exploratory modeling and analysis, will have to be evolved or developed. Also, collaborative environments that permit multi-disciplinary participants to tailor an interoperable mix of tools and databases for the assessment of a range of C4ISR issues will be needed to help deal with the growing complexity of the assessment problem and the change triggered by continually emerging new technology.

New Culture and Processes. Finally, there is the need to establish a new culture of openness and cooperation in which data are readily published and shared and participants from many different communities are motivated to collaborate across traditional organizational boundaries. In this new environment, the C4ISR community will have to work cooperatively with the many new C2 participants, as well as those from the mission assessment and experimentation communities. Such new processes would be facilitated by the collaborative assessment environments noted above.



Key Insights from Tutorials (1 of 2)

- Track I (Selected M&S)
 - Key problems
 - Acquiring needed data
 - Treatment of uncertainty when the number of variables is very large
 - Potential approach
 - Employ a multi-resolution family of M&S
 - Tailor to the specific analytical problem

Track I of the tutorials was moderated by Joe Jennings, MITRE. The track featured five presentations which employed models and simulations (M&S) to assess C4ISR in diverse ways:

- *Explicit* representation of C4ISR effects in *constructive* simulations (JWARS, Pegasus);
- *Explicit* representation of C4ISR performance and interoperability in *engineering* simulations (Simulation Based Acquisition (SBA));
- *Stimulation* of real-world or prototype C4ISR systems and human actors by *virtual* simulations (Joint Semi-Automated Forces); and,
- *Implicit* representation of C4ISR effects in high level analytic models (Mission-System Analysis of the Halt Problem).

Two common problems were observed across the presentations: the challenge in acquiring needed data and the treatment of uncertainty when the number of variables is too large for traditional sensitivity analysis. One potential way of dealing with these issues is to employ a multi-resolution family of M&S that is tailored to the specific analytical problem.



Key Insights from Tutorials (2 of 2)

- Track II ("Unorthodox" approaches)
 - Potential value of employing Effects Based Analysis
- Cross-cutting Tutorial (DSC)
 - Joint Mission Area Analysis Tool (JMAAT) to examine interactions among C4ISR systems
 - Linked data bases — M&S, studies, POCs

Track II of the tutorials was moderated by Professor Bill Kemple, Naval Postgraduate School. The track featured a broad set of C4ISR assessment techniques, many of which represented unorthodox approaches for the OR community. They included:

- A perspective on the tools and approaches cited in the NATO COBP for C2 Assessment.
- The use of Influence Diagrams and Bayesian Networks to examine probable effects of actions or events on targeted decision makers (Situational Influence Assessment Module (SIAM)).
- The collection, organization, and application of cultural information to support psychological operations and coalition teamwork (Cultural Logic).
- The use of interactive functional decomposition diagrams to assess the impact of C4ISR system improvements at the mission level (Quantitative Threshold Assessment (QTA)).
- The application of the "New Sciences" to analyze warfare (Project Albert).

Integrating across these presentations, it was observed that Effects Based Analysis may prove to be a useful template to cover all of the mission areas considered at the workshop.

In addition, Keith Dean, DSC, provided a tutorial that described the Joint Mission Area Analysis Tool (JMAAT) and the DSC databases.

- JMAAT uses C4ISR ISP to examine interactions with other C4ISR systems, showing the availability today and five years hence.
- DSC has three linked C4ISR databases: M&S, studies and points of contact.



Key Insights from Luncheon Speakers (1 of 2)

- Air War Over Serbia (AWOS) Analysis of Lessons Learned, Col J. Negron
 - We inevitably demand an immediate “lessons learned” report after an operation
 - ... However, we are rarely prepared to perform it!
- Towards a Unified Theory of Combat, M. Herman
 - Physical - historically, the primary focus of analyst attention
 - Reason - beginning to be addressed (e.g., ONR, MORS WG)
 - Belief - largely unaddressed by the analyst

Looking back over 2000 years of history, the luncheon speakers provided important insights into the nature of the problem facing the C4ISR analyst.

Col Jose Negron, AFSAA, reflected on the challenge posed to analysts in the most recent of those operations, AWOS. He observed that although we inevitably demand an immediate “lessons learned” report after an operation, we are rarely prepared to perform it. This is due to data collection challenges, the dearth of tools needed to transform data into meaningful measures of merit, and the limited capability to perform “what if...” assessments. He noted that the AWOS project was able to overcome those hurdles, but steps should be taken by the assessment community *before* future operations to facilitate the timely, responsive generation of lessons and the ability to discern which lessons are likely to apply to future operations.

Mr. Mark Herman, BAH, sought inspiration in the “DOTML-PF” of the Mongol hordes to make progress towards a unified theory of combat. This included insights into their weaponry, transport, tactics, and psychological operations (e.g., intimidating their adversaries with the stench of their unwashed bodies). He observed that a meaningful assessment of operations must include consideration of three domains: physical (e.g., maneuver, strike, protection), reason (e.g., situational awareness, communications) and belief (e.g., leadership, unit cohesion, morale). Historically, the assessment community has focused on the physical domain. Recently, additional attention is being given to the reason domain, but the belief domain is rarely addressed.



Key Insights from Luncheon Speakers (2 of 2)

- Gettysburg, A Strategic and Operational Perspective, Prof. L. Fullenkamp
 - There is a critical human dimension of conflict that must be captured in our assessments
 - E.g., Lee's reliance on JEB Stuart for intelligence at Gettysburg

Professor Len Fullenkamp, USAWC, provided a strategic and operational perspective on the Battle of Gettysburg. He focused on the human dimension that proved decisive in the battle — the absence of JEB Stuart and his cavalry during the formative stages of the battle and Lee's dependence on those forces for critical intelligence. He surmised that the human dimension can be critical in conflict and that we must capture it in our assessments.



Nature of the Problem: "BFOOs" (1 of 3)

■ Concepts

- "C4ISR" is not a single word!
- It can be parsed several ways; e.g.,
 - C = Command (function)
 - C2I = Command-Control and Intelligence (processes)
 - C4ISR = the system to effect the processes
- Sometimes, it needs augmentation to reflect the *true* nature of the problem (e.g., C7I3SR for HA/DR)

■ Tools

- "All models are wrong -- some are useful"
- No one tool will ever be sufficient to address the breadth of C4ISR issues -- we will need a flexible spectrum of carefully orchestrated tools

Several "Blinding Flashes of the Obvious" were captured by the Synthesis Panel as they participated in the deliberations of the individual mission-oriented panels. Several of these BFOOs are summarized below.

• **Concepts.** Many of the panels initiated their deliberations by discussing what is meant by "C4ISR." After much discussion, it was universally recognized that confusion is caused because "C4ISR" is not a single word. It subsumes functions (e.g., command), processes (e.g., intelligence) and systems (e.g., communications, computers). It was further noted that the term sometimes needs augmentation to reflect the true nature of the problem. For example, in an earlier MORS Workshop on OOTW (Ref 1), the phrase "C7I3SR" was introduced (tongue in cheek) to emphasize that in peace operations, attention must also be paid to cognition, consultation, coordination, information and integration.

• **Tools.** During the course of the deliberations, Gene Visco, FS observed that "all models are wrong — some are useful." This triggered the epiphany that no one tool will ever be sufficient to address the breadth of C4ISR issues. To attack this set of complex, poorly defined issues we will need a flexible spectrum of carefully orchestrated tools. For example, many of the issues associated with immature mission areas (such as coercion or counterterrorism) will require the coordinated application of expert elicitation, influence diagrams, system dynamics models, live experiments and constructive/virtual M&S.



Nature of the Problem: "BFOOs" (2 of 3)

■ Data

- Walt Laberge was right!
- "Without Data We Are Nothing!"

■ Problem decomposition

- It was useful to decompose the mission space into New World Disorder Missions (e.g., coercion, peace operations, counterterrorism, urban warfare)
- However, it must be recognized that all of these missions can occur simultaneously! (e.g., contemporary events in Middle East)

• **Data.** During MORS' workshop on SIMTECH 97 (Ref 2), Walt Laberge, then PDUSDRE, gave a plenary presentation entitled "Without Data We Are Nothing!" In that talk he argued persuasively that in the absence of verified, validated and certified data we lack the foundation for creating reliable assessment tools or providing credible inputs for our existing tools. In the absence of that data, we are unable to shed light on the major issues that confront the decision maker. There was universal agreement that Dr. Laberge's observations are as germane today as they were twelve years ago.

• **Problem Decomposition.** In order to deal with the broad spectrum of "New World Disorder" missions, the Workshop elected to decompose these missions into the categories of coercion, peace operations, counterterrorism/WMD and urban warfare. Although this decomposition proved to be intellectually useful (and challenging) it must be emphasized that this decomposition is artificial. In fact, in the current upheaval occurring in the Middle East, all of these missions are occurring simultaneously. Thus, analysts must be prepared to address issues where the full panoply of missions are in effect.



Nature of the Problem: “BFOOs” (3 of 3)

■ Relative maturity

- There is an enormous disparity in the relative maturity of our ability to do “C4ISR” analyses within the context of the 5 operations types
- This maturity ranges, from highest to lowest, as follows
 - MTW
 - Peace operations/humanitarian relief
 - Urban Warfare
 - Coercion
 - Counterterrorism/WMD

• **Relative Maturity.** It became quite apparent during the course of the workshop that there is an enormous disparity in the relative maturity of our ability to do C4ISR analyses within the context of the five missions of interest.

Even though the MTW group expressed displeasure with the quality of our data and tools, it is clear that the maturity of this mission area far transcends that of the others. In recent years, our experiences in peace operations (most notably in Bosnia and Kosovo) have given rise to marked improvements in our ability to assess those types of operations. However, as a recent NATO Workshop conducted by NATO SAS-026 revealed (Ref 3), there are still many challenges in doing C4ISR assessments, particularly in the areas of measures of merit, data, tools and sensitivity analyses.

In the area of urban warfare, there is a long history of conflict in that environment. However, recent experiences in the field (e.g., Russian experiences in Grozny) and experiments (e.g., the USMC’s Urban Warrior) reveal that we are ill-prepared to perform C4ISR assessments in that context.

Similarly, coercion campaigns have been conducted since time immemorial, most recently in convincing Slobodan Milosevic to pull his troops out of Kosovo. However, the new dimension of Information Operations (IO) and the need to explore military, diplomatic and economic options in concert, has introduced new levels of complexity to the analysis.

Finally, in the area of counterterrorism, where the US is beginning to prepare for the possibility of catastrophic homeland events, there are major uncertainties in roles, missions, organizational relationships and concepts of operations. At this primitive stage in our understanding of the nature of the problem, we are ill-equipped to perform C4ISR assessments in this context.

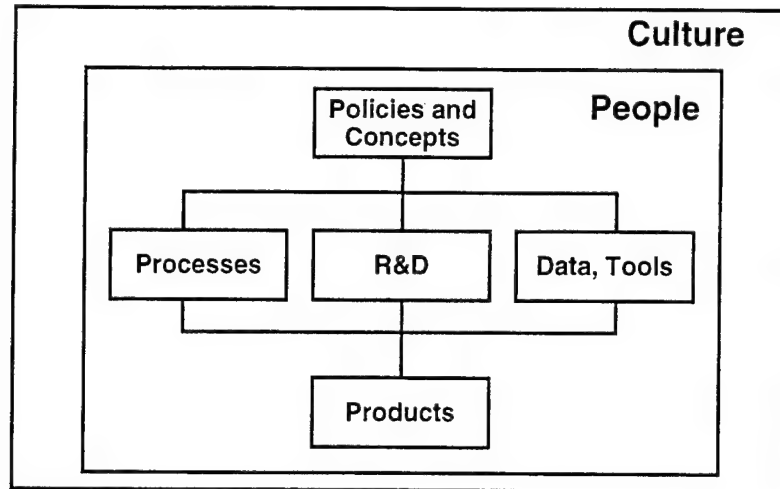


Agenda

- Panel goals, composition, plan of attack
- Insights on nature of the problem
- Preliminary plan of action
- Summary

This section of the briefing describes the preliminary plan of action for redressing C4ISR assessment shortfalls that were identified by the Synthesis Panel. As a context for this preliminary plan of action, the panel adopted a "Business Process Re-engineering" (BPR) framework. Using that framework and insights developed by the five mission-oriented panels, the Synthesis Panel identified a broad spectrum of initiatives. Many of these initiatives are appropriate for the MORS community to pursue. However, many require the long term efforts of the Federal government. The latter are identified as candidates for inclusion in the Plan of Action and Milestones (POA&M) that the DSC will generate, based, in part, on the findings and conclusions of this workshop.

Framework for a Plan of Action



The accompanying figure provides a BPR perspective of C4ISR assessment. The Synthesis Panel concluded that if we are to advance C4ISR assessment successfully in a dynamic environment, we must consistently address *all* of these factors. The backdrop for these factors is set by the *cultures* of the many communities that must participate in C4ISR assessments of “New World Disorder” missions. It was recognized that in many mission areas DoD would not have the lead responsibility. Thus, we must be cognizant of the cultures of the other participants and flexible in our interactions with them.

Second, *people* are critical components of future C4ISR assessments. This implies the need to provide critical Education and Training (E&T) for both the analysts and the recipients of those analyses. Within this framework, key *policies and concepts* must be formulated that recognize the cultural heterogeneity of the participants and seeks to bridge those differences. This establishes the context for four key areas: the *data* needed to support the assessments, the *tools* that are required to treat adequately the nature of the C4ISR problem, the *processes* that are employed in performing the assessments, and the *R&D* that is needed to address critical conceptual shortfalls.

Finally, key *products* are needed to document and encourage the production of exemplary C4ISR assessments by the community.



Key Elements of a Plan of Action (1 of 6)

■ Culture

- (START) Initiate actions (e.g., meetings, coordination efforts, socialization) to *breakdown barriers with the diverse communities* who must participate in C4ISR assessments in selected mission areas (e.g., have MORS run a multi-community, *unclassified* workshop)

•**Culture.** Most of the mission-oriented panels observed that DoD would have to work with a large and diverse set of other organizations to perform credible C4ISR assessments (e.g., in support of C4ISR assessments of counterterrorism, the DoD would support organizations such as the Department of Justice and FEMA). Consequently, actions should be initiated to break down the cultural barriers with these diverse communities. As one preliminary step, it would be highly desirable if MORS were to conduct one or more multi-community workshop on "New World Disorder" C4ISR Assessment, at the *unclassified* level. It might be appropriate to conduct such workshops with other professional organizations that are sensitive to the cultures of the other key participants. For example, if a workshop were to be held on C4ISR assessment in the context of Peace Operations (PO), it might be advisable to team up with the Cornwallis Group, which has strong ties both to MORS and the PO community.



Key Elements of a Plan of Action (2 of 6)

■ People

- (START) Develop curricula, programs to *enhance education and training for the analyst*, emphasizing
 - Breadth of education (e.g., broader exposure to social sciences)
 - Just-In-Time (JIT) education and training (to respond to rapidly emerging missions)
 - Training in emerging tools (and COTS products)
 - Exposure of analysts to military operations (MORS, NDIA)

•**People.** Nearly every panel emphasized the E&T challenges that the analyst faces in dealing with “New World Disorder” C4ISR assessments. First, the issues in question require a much broader knowledge base than that of the typical analyst. For example, the assessment of peace operations requires an in-depth understanding of the social sciences (e.g., demography, sociology, anthropology, political science). Second, in view of the uncertainty in the nature and timing of the threat, JIT education and training is needed to respond to rapidly emerging missions (e.g., peace operations in East Timor). Third, as stressed in the tutorials, a significant new generation of C4ISR tools and methodologies is emerging. Some mechanism is needed to train analysts on the proper use of those tools. Finally, there is a need to expose analysts to operations (either real or simulated) to sensitize them to the realities of “New World Disorder” conflict.

To deal with the first two issues, it would be appropriate for the military schools and universities (e.g., NPS, AFIT, NDU) to develop curricula to support broader and JIT education and training. One option for enhancing the breadth of Operations Analysts (OA) is to attract new analysts with social science training and provide them with the E&T needed to acquire quantitative skills. The challenge to provide just-in-time E&T may prove to be more difficult. It may require the identification of regional experts who can be mobilized to assist in preparing OA to respond to an emerging crisis. Emerging advanced distributed learning technologies may prove useful in linking these experts to the analysts.



Key Elements of a Plan of Action (2 of 6) (Concluded)

■ People

- (START) Develop curricula, programs to *enhance education and training for the analyst*, emphasizing

- Breadth of education (e.g., broader exposure to social sciences)
- Just-in-time education and training (to respond to rapidly emerging missions)
- ➡ ■ Training in emerging tools (and COTS products)
- Exposure of analysts to military operations (MORS, NDIA)

•**People (Concluded).** To cope with the latter two issues, professional organizations have a substantial role to play. For example, MORS might consider conducting training sessions on new tools and methodologies in conjunction with the MORS Symposium. In addition, MORS might seek to sponsor trips to key exercises (e.g., National Training Center) or experiments (e.g., Millennium Challenge) to provide analysts with an operational perspective. These could complement existing activities such as the NDIA's sponsorship of visits to Green Flag at Nellis AFB, NV.

In addition, several panels observed that enhanced education and training is needed for the users of analysis as well as the analysts. It was noted that the users of analysis will require "check list," at a minimum, to ensure that they are "educated consumers" (e.g., prepared to understand and probe the risks associated with options). This is an issue that the DSC might consider as it formulates its POA&M.



Key Elements of a Plan of Action (3 of 6)

■ Policies

- (START) We must reassess existing policies which severely restrict the flow of data, information across institutional barriers -- *rebalancing* security concerns and the need to know

■ Data

- (ALTER) Extend the recommendation made at SIMTECH 1997 (and reiterated at SIMTECH 2007) to develop a *comprehensive DoD-wide program to provide the VV&C'ed data* needed to support C4ISR assessment (DSC)
- (START) Work with various organizations (e.g., JS, J8; OSD(C3I); MORS) to develop *standard ontologies for key domains* (e.g., military, C4ISR, operations analysis) that are consistent with the emerging IEEE Standard Upper Ontology

• **Policies.** Several panels observed that existing policies severely restrict the flow of data and information across the institutional barriers that separate the participating communities. For example, in counterterrorism operations, organizations at the federal, state and local level will participate, as well as commercial entities (e.g., CHEMTREC). Current security policies and procedures significantly restrict the dissemination and sharing of critically needed information among those participants. There is a need for the government to undertake a fresh rebalancing of security concerns and the need to know.

• **Data.** Every panel identified data availability as one of the key impediments to effective C4ISR assessment. To redress this issue, a recommendation made at SIMTECH 97 (Ref 2) (and reiterated at SIMTECH 2007 (Ref 4)) should be implemented and extended. Those workshops recommended that a comprehensive DoD-wide program should be undertaken to provide the verified, validated and certified data needed for assessment. In view of the involvement of communities that transcend the DoD in C4ISR assessments, that recommendation should be broadened to include the data of other relevant communities, where feasible. The DSC is well-positioned to initiate this activity. However, because the data in question goes beyond that of DoD (e.g., involving data controlled by other executive agencies, international organizations, NGOs) it may require the efforts of an organization with a broader charter.



Key Elements of a Plan of Action (3 of 6) (Concluded)

■ Policies

- (START) We must reassess existing policies which severely restrict the flow of data, information across institutional barriers -- *rebalancing* security concerns and the need to know

■ Data

- (ALTER) Extend the recommendation made at SIMTECH 1997 (and reiterated at SIMTECH 2007) to develop a *comprehensive DoD-wide program to provide the VV&C'ed data* needed to support C4ISR assessment (DSC)
- (START) Work with various organizations (e.g., JS, J8; OSD(C3I); MORS) to develop *standard ontologies for key domains* (e.g., military, C4ISR, Ops Analysis) that are consistent with the emerging IEEE Standard Upper Ontology



• **Data (concluded).** An ontology is a set of concepts (defined by axioms and relationships) for a domain of interest which computers can process. The IEEE is now developing a Standard Upper Ontology that will provide the foundation for domain ontologies.

Just as the High Level Architecture (HLA) aids federated modeling, compliance to standard ontologies will improve interoperability of both data and its semantics. If such standard ontologies were to be developed, legacy models would need to be mapped only once, not n-squared times. In addition, such ontologies would enable automated inferencing.

Consequently, it is recommended that standard ontologies be developed for key domains such as "military," "C4ISR" and "operations analysis." At the outset, significant progress can be achieved with volunteers.



Key Elements of a Plan of Action (4 of 6)

■ Tools

- (START) MORS should convene a workshop to address/compare *attrition vs effects-based assessment*
- (START) A *collaborative environment* for C4ISR assessment is needed that can cope with all the dimensions of DOTML-PF
- (START) A new set of tools is needed to support the assessment of the emerging C4ISR infrastructure (e.g., GIG)

• **Tools.** A number of panels observed that the traditional attrition-based approaches to analysis are not relevant to key “New World Disorder” missions. They stressed the importance of effects-based assessment in which a variety of techniques might be employed to achieve desired results. For example, in coercion operations a decision maker may have to decide upon the proper balance of diplomatic, economic or military (lethal and non-lethal) actions to achieve desired objectives. Since the field of effects-based assessment is in its infancy, it would be useful if MORS were to convene a workshop to address/compare attrition *versus* effects-based assessment.

In SIMTECH 97 (Ref 1), it was recommended that an analyst workbench be developed to help the analyst access and employ key tools and data. In the contemporary world, where most meaningful C4ISR assessments require teams of analysts with complementary knowledge and skill, that concept should be expanded to a *collaborative* environment for C4ISR assessment. It is envisioned that such a collaborative environment would take advantage of state-of-the-art collaboration tools (e.g., Info Workspace) to enable the analyst teams to cope with all of the dimensions of DOTML-PF.

OSD and the Joint Staff are in the process of developing architectures to implement a proposed Global Information Grid (GIG). A new set of tools is needed to support the assessment of this emerging C4ISR infrastructure.



Key Elements of a Plan of Action (5 of 6)

■ R&D

- (ALTER) Recast and continue to pursue the recommendation made at SIMTECH 1997 (and reiterated at SIMTECH 2007) to develop a *comprehensive DoD-wide program to perform research into "soft factors"* (i.e., Mark Herman's domains of Reason and Belief) (DMSO, ONR)

■ Process

- (CONTINUE) NATO SAS Panel should continue the extension of the NATO COBP for C2 Assessment to other mission areas

• **R&D.** In SIMTECH 97 it was recommended that a comprehensive DoD-wide program should be undertaken to perform research into "soft factors". This subsumed the domains of "reason" and "belief" that Mark Herman emphasized in his luncheon address. In SIMTECH 2007 it was observed that little R&D into "soft factors" had been undertaken during the past decade and they reiterated the importance of undertaking such a comprehensive program. That recommendation is of continuing relevance. It would be appropriate for DMSO, in concert with appropriate research organizations (e.g., ONR, DARPA), to champion such a comprehensive program. Such an effort should take advantage of relevant initiatives in the community (e.g., the Naval Air Warfare Center Training Systems Division's recent solicitation for a behavior representation program (Ref 5)). In addition, R&D is required to understand better the effects of lethal and non-lethal attacks on such critical resources as command personnel, facilities and C4ISR resources.

• **Process.** As reported during the plenary session, NATO SAS-026 is in the process of extending the NATO COBP for C2 Assessment from conventional warfare to OOTW. Although such an extension is of great importance to the community, it is not sufficient. The NATO SAS Panel should be encouraged to extend the COBP to the full panoply of "New World Disorder" missions (e.g., coercion, counterterrorism).



Key Elements of a Plan of Action (6 of 6)

■ Products

- (START) MORS should devote a *special issue of Military Operations Research* to the application of the NATO COBP for C2 Assessment to selected case studies to encourage the use of the COBP in future assessments
- (START) Conduct a *Middle East case study* to begin to understand the C4ISR implications of a mix of complex missions (e.g., coercion, counterterrorism, urban operations, peace operations)

• **Products.** There is a need to provide a set of exemplary products to the community to help guide improved C4ISR assessments. One useful step would be to devote a special issue of the journal *Military Operations Research* to the application of the NATO COBP for C2 Assessment to selected case studies.

Current events in the Middle East provide an example of a mix of complex missions (e.g., coercion, counterterrorism, urban operations, peace operations). This is an important event and steps should be taken to capture “lessons learned” to support future C4ISR assessments in these mission areas.



Agenda

- Panel goals, composition, plan of attack
- Insights on nature of the problem
- Preliminary plan of action
- Summary

This section briefly summarizes some of the Synthesis Panel's major findings and conclusions.



Summary (1 of 2)

- Three of the “longest poles in the tent” have been emphasized in nearly every panel
 - *Educating/training* the analyst
 - The need for *data*
 - Coping with “*soft factors*” (i.e., reason, belief)
- As a minimum, *coordinated cross-community efforts* are needed to begin to address these issues systematically
- In the future, all of the mission areas should evolve from attrition based assessment towards *effects-based assessment*

It was notable that nearly all of the workshop panels emphasized three areas where shortfalls limit our ability to perform effective C4ISR assessments: educating and training the analyst, acquiring needed data and coping with “soft factors” (e.g., representing reason and belief in our assessments). As a minimum, coordinated cross-community efforts are needed to begin to address these issues systematically. It is important that these efforts extend beyond the DoD because of the important roles that other organizations play in key mission areas.

In addition, there was a growing consensus among the participants that classical attrition-based assessment is inappropriate for the new missions where C4ISR assessments are needed. There is a sense that effects-based assessment represents the appropriate approach to those problems. As noted above, it would be extremely valuable for MORS to conduct a workshop on attrition-based *versus* effects-based assessment to clarify this issue.



Summary (2 of 2)

- Consideration should be given to identifying “*Champions*” for key mission areas to provide leadership, consistency of purpose (e.g., perhaps SOCOM or the JWAC could represent coercion operations in key fora)
- There is a need to *transform the C4ISR assessment process* as we transform the force

Several panels observed that progress in C4ISR assessment in their emerging mission areas was hampered by the absence of a “champion.” They noted that such a champion would provide needed leadership and consistency of purpose. As an example, it was suggested that organizations such as SOCOM or the JWAC could effectively represent coercion operations in key fora. Comparable champions are needed for counterterrorism/WMD, urban warfare and peace operations.

Finally, it was emphasized that we can not be content to advance the C4ISR assessment process marginally. As noted earlier, a dramatically new DoD context has emerged over the past decade. This new context poses new DoD assessment challenges and raises a new agenda for C4ISR assessment. This agenda requires improvements in three areas: A more comprehensive analytical construct (e.g., characterization of new missions, metrics/methods for effects-based outcome, representation of “soft factors”), new assessment capabilities (e.g., data for new dimensions, enhanced education and training, a mix of new tools including collaborative environments) and a new culture/process for assessment (e.g., coupling to new participants, mission assessments, advanced warfighting experimentation).



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- The references cited in the text are listed below

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Approved Working Version



Terms of Reference **Workshop on** **Advancing C4ISR Assessment** October 31 – November 2 2000 Army War College, Carlisle Pennsylvania

0. Changes in this Version

A new Tentative Agenda has been included and adjustments have been made to Working Group leaders.

1. Background

Within the last ten years, there has been a growing realization of the importance of C4ISR to the successful execution of the broad range of the missions that the military must perform throughout the conflict spectrum. However, it is recognized that the military assessment community's methodologies and tools do not treat C4ISR adequately. This deficiency limits our ability to support decisionmakers involved with:

- Operations (e.g., identify and implement the C4ISR needed to support a military operation);
- Acquisition (e.g., support the lifecycle tradeoffs associated with the acquisition of a major C4ISR system);
- The Planning, Programming, and Budgeting System (PPBS) (e.g., allocate resources in a balanced way within C4ISR programs or between C4ISR programs and weapons systems); and
- Architecture development (e.g., formulate the C4ISR system of systems needed to support a given mission area, such as National Missile Defense).

During the past decade, MORS has convened several workshops that have addressed many of the subordinate issues associated with the credible treatment of C4ISR in assessment methodologies and tools. For example, in each of the following workshops, working groups were established to explore the C4ISR dimensions of the problem: C3IEW Measures of Effectiveness, Joint Requirements Operational Capability (JROC) Analysis, Operations Other Than War (OOTW) Analysis Methods and Techniques, and Quick Response Analysis Requirements and Methodologies (QRAM).

This series of workshops culminated in October 1998 with a MORS workshop on C4ISR Analysis for 2010. That workshop drew upon the Code of Best Practice for C2 Assessment that was developed by NATO's Studies, Analysis, and Simulation (SAS) Panel – 002. It was concluded that there were substantial deficiencies in the military assessment community's ability to perform all of the necessary functions associated with C4ISR assessment:

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- problem formulation;
- coping with organizational issues;
- characterizing appropriate scenarios;
- developing meaningful measures of merit (MoMs);
- assembling verified, validated and certified (VV&C'ed) data;
- developing verified, validated, and accredited (VV&A'ed) tools to evaluate the MoMs; and
- Performing sensitivity analyses to enhance confidence in the conclusions of the assessments.

These deficiencies were recognized in each of the mission areas that was addressed during the Workshop (e.g., major theater war (MTW), OOTW, Critical Infrastructure Protection (CIP), Peacetime Engagement).

Having identified these deficiencies in our ability to perform credible C4ISR assessments, the challenge is to formulate a plan of action to ameliorate these shortfalls.

2. Goals, Objectives, & Scope

The overall goal of the C4ISR assessment workshop is to formulate a plan of action to ameliorate the deficiencies that currently restrict the ability of the military assessment community to perform assessments that treat C4ISR adequately.

Consistent with this goal, this workshop will afford the military assessment community and subject matter experts the opportunity to exchange information on the state of the practice and art in C4ISR assessment and raise awareness of the shortfalls that limit our ability to perform assessments consistent with the needs of the decisionmakers.

In order to satisfy this goal, a number of objectives will be addressed. These include the following:

- a. An identification of useful Measures of Merit for C4ISR assessments, particularly for New World Disorder missions;
- b. An exploration of the methodologies that will help identify transformation functions that link the various levels of Measures of Merit (e.g., $MoE = f(MoPs)$);
- c. The creation of a compendium of assessment techniques that have been used to assess the impact of C4ISR on mission effectiveness. This compendium will include descriptions of the techniques, an assessment of their capabilities and limitations, and an articulation of the data sets that must be collected to implement the techniques.

Because the overall dimension of this subject area is enormous, it is important to scope the effort consistent with the resources available during a three-day workshop. To that end, limitations must be placed on:

- The decisionmakers that would be supported (e.g., operations, acquisition, PPBS, architecture);

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- Mission areas of interest (e.g., MTW, smaller scale contingencies, urban warfare, coercive operations, peace operations, non-combatant operations (NEO), humanitarian assistance, disaster relief).

It is tentatively decided to restrict the decisionmaker of interest to one charged with PPBS deliberations and to limit the mission areas of interest to MTW, urban warfare, coercive operations, and humanitarian assistance.

3. Issues

Within the context of these goals and objectives, the workshop should consider the following issues in developing approaches to analysis and structure of tools, measures, and data requirements.

- How do we measure success in missions where LER is clearly inappropriate? In these cases, is there a clear and measurable relationship between the performance of C4ISR systems and the attainment of mission goals?
 - What influences performance of the antagonists?
 - What contributes directly to mission accomplishment of our own forces? Where it is difficult to measure direct contribution, can we measure or detect what C4ISR circumstances hinder our own forces?
- What is the value of negative information in influencing mission performance?
 - How can we quantify the value of knowing what has not happened?
 - Can we tie value to knowing where the enemy is not located?
- Is there apparent value in being able to separate participants into Friend, Foe, Opposing Combatants, Neutral for the various missions?
 - What issues does this pose for analyzing Identification Issues?
- What analytic infrastructure is required?
 - Tools
 - Data Derivation/Validation
 - Blue force communication requirements
 - Blue force C2 Heuristics
 - Red Force communications behavior
 - Red force C2 Heuristics
 - Red force movement behavior
 - Red force MASINT susceptibility
 - Red force SIGINT susceptibility

4. Approach

To address the issues identified for this workshop, the approach will be to organize working groups to address military operational types. This uses a portion of the structure of the previous C4ISR meeting, so that previous progress can be used as a baseline for this effort. Type scenarios may be used to focus each group on its objectives during the workshop.

To generate answers to meet workshop goals, an analysis planning paradigm is suggested. That is, each working group should pick for itself a scenario – actual or hypothetical – in its assigned mission area. By then posing its problem in operational or acquisition decision terms, each group can develop the issues to be addressed and the measures of merit that are appropriate to assess those issues at both the force and system levels. At this point, the tools and methods to gather the information and the data types required to conduct the analysis will be identified and documented.

In order to ensure progress over previous workshops, each working group will be asked to develop a “strawman” answer that represents the state of current knowledge and effort. That strawman will then be reviewed, modified, and extended by the working group during the workshop.

The working groups and their assigned mission areas are described below.

MTW -- This group will seek to generate answers to the issues in conventional warfare against a traditional opponent based on the DPG scenarios. The group should consider the analytic and data demands of emerging warfare concepts that may be applied either offensively or defensively, such as:

- **Nodal Strike.** Here the working group should address the unusual measures of merit that may be required and the analytic demands levied when we choose to strike with force and accuracy at predetermined targets that will destroy the adversary's will to continue in opposition.
- **Asymmetric Warfare** -- An acknowledged segmentation of warfare where the opposition does not choose to match our force structure with equivalent forces or tactics. A sub-set of this type of engagement is one where an adversary has a relatively small number of highly lethal assets or methods (e.g. terrorism) that can be used to dissuade us from engaging according to normal TTP.

Coercion Operations (e.g. Kosovo) -- Similar to MTW in that it involves applied force, but distinct in that it is intended to coerce a response through asymmetric application of US military power. This type of operation potentially poses a different set of analytic challenges since targets and responses may or may not be military in nature. Sensitivity to “national interest” is likely to be heightened with the concomitant reticence to absorb casualties or endure negative public opinion. The considerations of asymmetric warfare apply to this working group as well.

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Peace Operation/Humanitarian Assistance -- This working group will continue to deliberations initiated in the previous workshop. For these operational missions where combat is an undesirable outcome, measures of performance for C4ISR systems may address general concepts like adequacy, and efficiency of systems and architectures, but linkage to measuring force effectiveness and mission outcome is more tenuous. There is also a potentially greater distinction between measures used operationally in a theater and measures used to support force structuring and acquisition decision making.

Urban Warfare -- A specialized consideration that can occur across the continuum of MTW through peacekeeping functions. Distinguishing characteristic is scenario and physical limitations brought on by environment.

Counter-Weapons of Mass Destruction/Terrorism -- The focus of this group is on C4ISR as it relates to deterrence, mitigation, response, and remediation/reconstitution of chemical or biological accidents, incidents, or terrorist events. In the area of deterrence, issues will revolve around ISR applied to threat detection and warning. Mitigation will focus on how information can be used to support contingency planning to reduce and control risk. Response will investigate the issues of first response and intergovernmental crisis command and control of operations. Finally, remediation and reconstitution will address the issues associated with longer term recovery from the effects of incidents. The group may deal with both foreign and domestic response situations.

Each of these groups will be asked to develop measurable characteristics that define performance at systems levels, functional levels, force effectiveness levels, and possibly effectiveness levels. Once such metrics are defined groups will identify "mapping functions" that describe the logical relationships between the levels of performance. Across the various mission types, these may be functions that are easily emulated in our current models, or they may be more esoteric, requiring research and further definition. To the degree that these transformations are identified and accepted, the working groups may arrive at near term suggestions for analytic progress and longer-term suggestions for research and development of tools, methods, and data. The groups will finalize their efforts by critiquing their actual ability to analyze the problem set thus created using today's tools and available data. Working groups may wish to break into subgroups to address mission or scenario variants, generating separate solutions and later integrating to generalize or identify areas of divergence.

Synthesis and Integration: This group will have the dual missions of synthesizing progress of the other groups into cross-cutting messages, and of defining methods for integrating the multiple mission areas in investment-oriented analyses. The synthesis function will monitor progress of the working groups, to identify common and divergent themes, and to cross-fertilize group methods and insights. The integration function will consider methods for relating the various demands and measures associated with different mission areas, while considering the utility and investment costs of new C4ISR systems. The objective is to identify methods to support decisionmaking in the next QDR. This group will present an overview of emerging themes at the conclusion of the workshop for the benefit of all participants.

5. Products

Several products will be generated from this workshop:

- A summary briefing of findings will be provided to the sponsors within 30 days.
- A final report will be produced separated into 2 distinct components within three months:
 - The first part will characterize the measures of merit that are recommended for use across the warfare areas in the workshop and the logical mapping functions that hold these measures together.
 - The second part will detail the ability of our analytical infrastructure to support such investigations. The report will be written in the form of a set of recommendations that may be the basis of a plan of action for the sponsors.
- An article summarizing the meeting and its findings will be produced and submitted to Phalanx within 3 months.

6. Administrative Details

- Dates: October 30 – November 2
- Place: Army War College, Carlisle Pennsylvania
- Classification: SECRET
- Registration fees are as follows:
 - U.S. Federal Government \$190; and others \$380.
- **Attendees**
 - 120 people, by invitation
- **Proponent:** OSD (C4ISR) [RADM Robert Nutwell]
- **Organizing Committee:**
 - Program Chair: Chuck Taylor
 - Co chairs: Dr Cyrus Staniec & Dr Stuart Starr
 - Working Group Chairs:
 - MTW
 - Mark Youngren, Chair
 - Kurt Willstatter, Co-Chair
 - Coercion Operations
 - Dick Hayes, Chair
 - Col Dave Anhalt, Co-Chair
 - Peace Operations/Humanitarian Assistance
 - Bob Holcomb, Chair
 - Bob Smith, Co-Chair
 - Urban Warfare
 - Chris Christianson, Chair

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- Warren Olson, Co-Chair
- Counter-WMD/Terrorism
 - Melissa Hathaway, Chair
 - Peter Merkle, Co-Chair
- Synthesis
 - Chair: Stuart Starr
 - Co-Chair LeLand Joe
- Other Personnel
 - Service Representatives:
 - Navy :
 - Army:
 - Marine Corps:
 - DMSO
 - J-8:
 - MORS Pubs Bulldog: Sue Iwanski

TENTATIVE MEETING AGENDA

Advancing C4ISR Assessment Workshop 30 October - 2 November 2000 Center for Strategic Leadership, US Army War College

AGENDA

(All activities are at Collins Hall, US Army War College)

Monday, October 30, 2000

Time	Activity	Speaker	Location
1200	Registration		Collins Hall Lobby
1300	Tutorials	Track 1 Track 2	Collins Hall 22 nd Infantry Conf Room Normandy Room, 3 rd Floor
1900	Working Group Chair Warm-Up	Mr. Chuck Taylor	Hampton Hotel, Room 216

Tuesday, October 31, 2000

Time	Activity	Speaker	Location
0730	Registration		Collins Hall Lobby
0830	Call to Order and MORS Welcome Workshop Overview	Dr. Roy Rice Mr. Chuck Taylor	Collins Hall 22 nd Infantry Conf Room
0900	Keynote Address	RADM Robert Nutwell	22 nd Infantry Conf Room
0930	C4ISR M&S Master Plan	Mr. Keith Dean	22 nd Infantry Conf Room
1015- 1030	Break	All	
1030	Presentation: Recent Advances	Dr. Stuart Starr	22 nd Infantry Conf Room
1115	Charge to WGs	Dr. Stuart Starr	22 nd Infantry Conf Room
1130- 1245	Lunch with Speaker	"Air War Over Serbia Analysis: Lessons Learned - - Col Negron, AFSAA	Ardennes Room
1300	First WG Session	WG Chairs	WG Rooms
1715	Mixer	All	Letort View Community Center

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Wednesday, November 1, 2000

Time	Activity	Speaker	Location
0730	Registration		Collins Hall Lobby
0830	Second WG Session	WG Chairs	WG Rooms
1130-1300	Lunch with Speaker	"Searching for a Unified Theory of Warfare," Mr. Mark Herman, BAH	Ardennes Room
1300	Third WG Session	WG Chairs	WG Rooms
1715	WG "Hot Wash"	Synthesis + WG Chairs Coordinate Day's Progress	22 nd Infantry Conf Room

Thursday, November 2, 2000

Time	Activity	Speaker	Location
0730	Registration		
0830	Fourth WG Session	WG Chairs	WG Rooms
1130-1230	Lunch with Speaker	"Gettysburg, A Strategic and Operational Perspective," Prof Len Fullenkamp, USAWC	Ardennes Room
1230	WG Brief outs	All	22 nd Infantry Conf Room
1500	WG Paper Reports	Synthesis + WG Chairs Complete first draft	WG Rooms

Milestone Plan

<u>Date</u>	<u>Task</u>	<u>Responsibility</u>
30 Jan	Initiate draft TOR procedure	complete
7 Mar	Select tentative dates	complete
14 Mar	Provide "For Comment" draft of TOR to Sponsors, VP(MO) and other interested organizations and individuals for review	MORS office
24 Mar	Revise TOR	Initiator, MORS office
24 Mar	Circulate final draft TOR to MORS Office and proponents for concurrence and to other sponsors and organizations for information	MORS office
3 Apr	Approve TOR, program chair, budget and fees	Executive Council
	Select working group chairs	Chair
11 Apr	Organizing Committee Meeting	Chairs, WG Chairs
~13 Apr	AWC Site Visit	Chair, MORS VPA
2 May	Develop List of Invitees	WG Chairs
1 Jul	Send out Speaker Invitations	Chairs
1 Jul	Mail Applications to Invitees	MORS office
8 Aug	Organizing Committee Meeting	Chairs, WG Chairs
25 Aug	Select read-ahead material	Chair
12 Sep	Organizing Committee Meeting	Chairs, WG Chairs
7 Sep	Select invitees	Committee
15 Sep	Assign nominees to working groups	Committee
	Provide read-ahead materials and releases to MORS office	MORS office
20 Sep	Mail read-ahead materials	MORS office
10 Oct	Organizing Committee Meeting	Chairs, WG Chairs
17 Oct	Pre-registration, security clearances, disclosures due to MORS office	Invitees
31 Oct	Conduct workshop	Chair/Committee
2 Nov		
30 Nov	Brief sponsors	Chair
29 Dec	Submit After-Action Report	Chair
26 Jan	Complete written products	Committee
23 Feb	Approve written products	Publications committee
30 Mar	Review approved products	Proponents
28 Apr	Distribute approved products	MORS office

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- **As described in the C4ISR TOR, to achieve WG consistency of effort and output, we plan to follow this Study Planning Approach**
 - **Problem Formulation**
 - **Organizational Aspects**
 - **Scenarios**
 - **Measures of Merit**
 - **Tools**
 - **Data**
 - **Sensitivity**
 - **Output**
- **Workshop planning team will review and agree on formats and details during planning sessions**

Appendix A - 12

Appendix B – List of Acronyms

AFIT	Air Force Institute of Technology
AFOTEC	Air Force Operational Test and Evaluation Command
AFSAA	Air Force Studies and Analyses Agency
AG	Adjutant General
AMC	Air Mobility Command (USAF)
ANG	Air National Guard
ARNG	Army National Guard
ASD(C3I)	Assistant Secretary of Defense (Communications, Command, Control and Intelligence)
ATCAL	Attrition Calibration
ATF	Alcohol Tobacco and Firearms
AWOS	Air War Over Serbia
BAH	Booz Allen and Hamilton
BDA	Battle Damage Assessment
BDI	Battle Damage Information
BOGSAT	Bunch of Guys Sitting Around a Table
BPR	Business Process Re-engineering
C2	Command and Control
C3I/C3ISR&SS	Command, Control, Communications, Intelligence Surveillance, Reconnaissance and Space Systems
C4ISR	Command, Control, Communication, Computers, Intelligence, Surveillance and Reconnaissance
CAS	Complex Adaptive Systems
CBNRHE	Chemical, Biological, Nuclear, Radiological and High Explosive
CINC	Commander in Chief
CIWG	Communications Interoperability Working Group
COAs	Courses of Action
COBP	NATO Code of Best Practice
COMINT	Communications Intelligence
CONOPS	Concept of Operations
CONUS	CONtinental United States
COTS	Commercial Off The Shelf
CROP	Common Relevant Operational Picture
DARPA	Defense Advanced Research Projects
DCO-S	Disaster Control Officers
DHHS	Department of Health and Human Services
DIA	Defense Intelligence Agency
DII-COE	Defense Information Infrastructure – Common Operating Environment
DLA	Defense Logistics Agency
DMSO	Defense Modeling and Simulation
DOE	Department of Energy
DOJ	Department of Justice
DOMS	Directorate of Military Support
DOTMLP-F	Doctrine, Operations, Training, Materiel, Leadership, Personnel, Forces

DSC	Decision Support Center
DTRA	Defense Threat Reduction Agency
E&T	Education and Training
EBR	Evidence Based Research
EMI	ElectroMagnetic Field
EOC	Emergency Operating Center
EOD	Explosive Ordnance Disposal
EPA	Environmental Protection Agency
FAIAWG	Federal Agencies Information Architecture Working Group
FBI	Federal Bureau of Investigation
FEBA	Forward Edge of the Battle Area
FEMA	Federal Emergency Management Agency
FORSCOM	United States Army Forces Command
FRP	Federal Response Plan
GIG	Global Information Grid
HA	Humanitarian Assistance
HAZMAT	Hazardous Materials
HEAT	Headquarters Effectiveness Assessment Tool
HLA	High Level Architecture
HUMINT	Human Intelligence
HV/LD	High Value/Low Density
I&W	Indications and Warning
IC	Intelligence Community
ID	IDentify
IDA	Institute for Defense Analyses
IO	Information Operations
IO/IW	Information Operations/Information Warfare
IPB	Intelligence Preparation of the Battlefield
IPI	International Public Information
ISP	Internet Service Provider
ISR	Intelligence, Surveillance and Reconnaissance
IT	Information Technology
JCATS	Joint Cartographic Analysis Tool Set
JFCOM	Joint Forces Command
JIT	Just in Time
JMAAT	Joint Mission Area Analysis Tool
J-MOUT	Joint Military Operations in Urban Terrain
JSTARS	Joint Strategic Targeting System
JTF	Joint Task Force
JTF-CS	Joint Task Force for Civilian Support
JWAC	Joint Warfare Analysis Center
KPB	Knowledge Preparation of the Battlefield
LER	Loss Exchange Ratio
LNO	Liaison Officer
M&S	Modeling and Simulation
MCTWG	Multimedia and Collaborative Tools Working Group

MITL	Man in the Loop
MLS	Multi Level Security
MOA/U	Memorandum of Agreement or Understanding
MOBA	Military Operations in Built up Areas
MoE	Measure of Effectiveness
MoFE	Measures of Force Effectiveness
MoM	Measure of Merit
MoP	Measure of Performance
MOUT	Military Operations in Urban Terrain
MTW	Major Theater War
NAWCTSD	Naval Air Warfare Center Training Systems Division
NCA	National Command Authority
NGB	National Guard Bureau
NGOs	Non-Governmental Organizations
NPS	Naval Postgraduate School
OASD	Office of the Assistant Secretary of Defense
OAT	Onsite Analysis Team
OCONUS	Outside CONTinental United States
ONR	Office of Naval Research
OODA	Observe, Orient, Decide, Act
OOTW	Operations Other Than War
OPLANS	Operations Plans
OPNAV	Naval Operations
OPSEC	Operational Security
OR	Operations Research
ORSA	Operations Research Society of America (now INFORMS)
OSD	Office of the Secretary of Defense
OSD	Office Secretary of Defense
PA	Public Affairs
PACOM	Pacific Command
PO	Peace Operations
POA&M	Plan of Action and Milestones
PVOs	Private Volunteer Organizations
QDR	Quadrennial Defense Review
QTA	Quantitative Threshold Assessment
R&D	Research and Development
RC	Reserve Component
RIGOR	Repeatability, Independence, Grounding, Objectivity and Robustness
RMA	Revolution in Military Affairs
ROE	Rules of Engagement
SAP	Special Access Program
SBA	Simulation Based Acquisition
SBCCOM	Soldier and Biological Chemical Command (US Army)
SCI	Special Compartmented Intelligence
SIAM	Situational Influence Assessment Model
SIGINT	Signal Intelligence

SME	Subject Matter Expert
SO/LIC	Special Operations/ Low Intensity Conflict
SOCOM	Special Operations COMmand
SOP&S	Special Operations Policy and Support
SOUTHCOM	SOUTHERn COMmand
SSC	Small Scale Contingency
SWOT	Strengths, Weaknesses, Opportunities, Threats
TPED	Target Processing Exploitation and Dissemination
TPFDD	Time Phased Force Deployment Data
TRADOC	Training and Doctrine Command
TRANSCOM	United States Transportation Command
UAV	Unmanned Aerial Vehicle
UN	United Nations
USACE	United States Army Corps of Engineers
USAF	United States Air Force
USMC	United States Marine Corps
USN	United States Navy
USSOCOM	US Special Operations Command
USSS	United States Secret Service
VVA	Verification Validation Accreditation
WG	Working Group
WMD	Weapons of Mass Destruction



Appendix C-1
WORKING GROUP STUDY PLAN
MORS C4ISR SYMPOSIUM AND WORKSHOP
COERCION WORKING GROUP
Dr. Richard E. Hayes, Chair
July 18, 2000

Issue: This working group will address the problem of how the US (alone or in a coalition) can coerce compliance by another government in a short time frame.

Story line: The year is 2010. In each of the countries listed below there are deep divisions along ethnic, political, or religious differences. Each country has an authoritarian government that depends on support from one segment of the population (e.g., a particular clan, ethnic, or religious group). Each government has a history of human rights abuses and discrimination against less powerful population segments. Recently, those abuses have escalated and include torture and overt destruction in the dissidents' homeland areas. The victim populations have responded on two levels. First, the more moderate have started a political campaign for governmental reform, human rights, and democracy. Others have started a violent resistance movement. The government has responded with brutal force and is deploying troops and organized thugs to displace the protesters and destroy their homes. The situation is critical and poses a major threat to the survival of the dissident population. Little time remains for effective intervention. Intelligence indicates that large-scale brutal repression, including "ethnic cleansing" is likely within days.

Conditions and Constraints We have chosen likely candidate countries from around the world because we do not want to be limited to solutions that are based on geography and specific basing. The US must have the capability to play an important role in all areas of the world. Thus we seek coercive approaches that are not geographically dependent (although geography may impose both constraints and limits to some of the tools and solutions). The regions and countries of interest for the analysis are:

- Europe: Bosnia (Muslim context) and Bosnia (Kosovo)
- Latin America: Guatemala and Peru
- Africa: Sierra Leone and Rwanda
- Middle East: Iraq and Yemen
- Far East: East Timor and Fiji

For each of these cases maps, relevant force structure information, and brief descriptions of the political, social, and economic situations are being prepared for use in the workshop. US objectives in all cases are to prevent the imminent campaign of violence and brutality, using force if necessary. In a given situation this may best be done in an *ad*

hoc coalition, through an established alliance, or unilaterally. In all cases, it will involve the use of a deterrence calculus.

Working Group Study Objectives The primary goal of this effort is to identify and develop information requirements and analytic tools to support decision-making and effective action in these kinds of situations. This will include identifying key gaps in the information likely to be available and holes in the available analytical tool kit. The working group will look at the information and tools available to address the key questions inherent in coercive operations such as:

- What can the US/Coalition do to stop/ameliorate the violence?
- What values do the government have that can be credibly threatened?
- How would the hostile government counter our moves?
- What are the intelligence (data, information and knowledge) needs for these analyses? How might they be identified and met?
- What are the logistics and logistic information requirements for each option? How might they be met?
- What are the C2 requirements for this mission? How might they be met?
- What are the relevant measures of merit, at all levels? (measures of policy effectiveness, measures of force effectiveness, measures of C2 effectiveness, measures of systems performance)
- What analytical tools do we have or need to develop? Where are the tool gaps?

Working Group Product The primary product from our working group is expected to be a list of the tools and techniques required. This implies, for each situation, a listing and analyses of:

- Instruments of coercion available including temporal considerations (What can be done, when and where, including preparation time.)
- What data, information, and knowledge are required to assess and support these options?
 - Operations
 - Intelligence
 - Logistics
 - Adversary values and capabilities
 - What responses and countermeasures do the adversary governments have in each instance?
 - What tools (models, simulations, analytic tools, collaboration tools, etc.) are needed? What data do they require? Does it exist?
 - What information and tool gaps exist?



Appendix C-2

Coercion Working Group

Scenarios

Bosnia 2010

In early 1999 the Republika of Srpska city of Brcko was declared neutral by an international body controlling Bosnia-Herzegovina. The city was made a separate district under joint state-level control. Brcko is important to the economy of Bosnia and Croatia and being the main transfer point on the Sava River. The city and its environs were demilitarized at the same time.

The demilitarization of Brcko divided the Republika along the critical Posavina Corridor, which strategically cuts all lines of communication between the Eastern and Western halves of Srpska. The Bosnian Serb Army (VRS), commanded by Colonel Vitch, was downsized and made to rely on the international peace keeping force for protection and early warning from an attack by the Federation of Bosnia Army.

In 2005 the international peace keeping force returned all of Bosnia-Herzegovina to local control and left the region. This was criticized by UN observers at the time for being too early a withdrawal because stability was not well established

In 2010 the Federation of Bosnia Army set up a base in Brcko in order to keep a watch on the black market smuggling across the Sava from Croatia. The Federation of Bosnia Army is composed of Muslin Croats and Bosnians. The Federation Army has 5 infantry battalions and 3 artillery battalions stationed in the district. The VRS has had recruitment drives but has not reached a strength or level of training in order to cause any problems for the Federation Army.

VRS Colonel Vitch has recently traveled to major cities in order to recruit new members with the expressed purpose of taking over Brcko and returning it to Republika of Srpska control. Reports indicate that he currently has over 20,000 well-armed soldiers. These are largely half-trained militia, but roughly 8,000 are well-trained veterans of the civil war, are mechanized, and equipped with tanks and artillery from Srpska. Conflict with the Bosnian Federation seems imminent.

Brcko government officials who report directly to the Bosnian Federation are concerned about the VRS statements and build-up, however the Bosnian Federation will not pull back its troops (2 infantry battalions). On July 5, 2010, the VRS initiated an artillery bombardment of Brcko. VRS patrols are venturing into the suburbs of Brcko and are reportedly committing atrocities among the Muslim inhabitants. Colonel Vitch has declared that Brcko will be a pure Serbian city once again.

East Timor 2010

Two years after the 1999 referendum on independence East Timor became an independent republic recognized by all nations except Indonesia. In December 2001 elections were held and FRETILIN, the E. Timor Nationalist party, won bringing Xanana Gusmao and Jose Ramon Horta to power as President and Vice-President respectively. The main policy of the new government was the reconstruction of damaged infrastructure and housing as well as promoting the reconciliation of the former warring parties. At the same time, some 2,000 anti-independence militiamen under Eurico Guterrez along with some 30,000 civilians (mostly civil servants and people with strong ties to Jakarta) fled to western Timor.

Reconstruction was slow, but with the help of abundant foreign aid East Timor, by 2009, was well on its way to a real recovery. Great hope is placed in the joint East Timor/Australia offshore oil exploration in the Timor Sea to bring in foreign exchange and investment. Security of the new republic is the responsibility of the East Timor Defense Force. This new force benefits from the experience of many former FALANTIL guerillas and consists of 4 light infantry battalions armed with small arms and mortars and 2 cavalry squadrons equipped with 50 LAVs. There is also a combined air force and navy equipped with 6 ex-US Blackhawk helicopters and 3 ex-Australian coastal patrol boats armed with Harpoons and 40mm cannon.

Things were also taking shape in Indonesia. In October 2008 the government of President Megawati Sukarnoputri was overthrown in a military coup led by hard-line General Wiranto. His platform was that Indonesia was disintegrating and needed strong centralized power to rebuild itself and eventually regain lost territories. One of his first actions was to reconstruct the militia force of Eurico Guterrez in western Timor. This was done by local recruitment and the mobilization of the paramilitary Peoples Resistance Militia or WANRA. By April 2010 Guterrez had assembled a force of 6,000 militia armed with small arms. It calls itself the Patriotic Unity Force or PUF. In May the PUF infiltrated E. Timor and took control of the cantons of Bobonaro and Cova Lima.

In the two conquered cantons, Guterrez' militias began acting in much the same way as his anti-independence militias had acted in 1999. That is to say they murdered, looted, and burned. The towns of Fohorem and Balibo have been very badly hit and large numbers of civilians have been murdered. The East Timor Defense Force is holding the invaders back along the Atabee/Zumalai road with difficulty. A small resistance force made up of former FALINTIL guerillas has formed in the occupied territories and is conducting ambush and sniping operations against the PUF.

Intelligence reports that the Wiranto regime in Indonesia is planning to reconquer East Timor under the pretext of restoring order. The 12,000-man Indonesian Marine division and two airborne brigades have been put on alert and preparations are being made to move them to western Timor. Once they arrive Wiranto is planning to send them into East Timor. It should take about three weeks to organize the logistics of this move.

After several years of relative calm and prosperity due to a boom in tourism and sugar, Fiji's native islander-dominated military high command has overthrown Mahatma Roon, the newly elected ethnic Indian prime minister, and his government. Roon's election strategy had been the nationalization of property in Fiji for equitable redistribution among Indians and native islanders. This policy was vehemently opposed by native islanders who have traditionally had permanent ownership of about 84 % of all land in Fiji. The stated policy of the new military dictatorship is Fiji for the Fijians and the deportation of all uncooperative "alien" elements. Roon and other prominent ethnic-Indian public figures including business leaders have been arrested and their fate is unknown.

Fiji's 3,500 man, infantry based, army has been put on alert and the reserves (some 6,000 soldiers) have been mobilized. The new military junta has put all of Fiji under martial law and basic civil rights have been suspended. These troops have been concentrated on the two main islands with some 5,000 in Suva and 4,500 in Lubasa. All tourism flights into Suva and Lubasa airports have been suspended. At the same time a native-islander militia, calling itself the "Sons of Vanua" has "spontaneously" formed. Roving armed bands of these militia have begun looting and burning Indian businesses in Suva and some have occupied Indian operated sugar plantations, claiming that the land belongs to native islanders. So far there have not been any reported deaths, but incidents of beatings and rape have been numerous. The military government, although not officially endorsing the "Sons of Vanua", has done nothing to stop their rampage or to protect ethnic-Indians most of whom are concentrated in the cities of Suva and Lubasa.

Ethnic-Indian activists have called for a return to democracy and the rule of law. Some ethnic-Indians, led by Dayananda Ariyawansa, a prominent commodities trader recently returned from Singapore, are advocating taking up arms to defend themselves against the militias, and have called upon India to supply them with arms. So far, the Fijian army has intercepted 2 small arms shipments smuggled in by powerboat along the North coast of Vili Levu. Customs officials intercepted 10 pounds of Semtex explosive hidden in the boots of an Indian travelling in from Kuala Lumpur.

Retired Major General Rabuka, a former statesman (he is a native-islander) who successfully mediated in previous crises has called for dialogue and a return to calm. General Rabuka has the respect of native-islanders and ethnic-Indians alike for his skill and fairness in handling delicate issues

The United States, Australia, and New Zealand have cut off all military ties with Fiji and trade sanctions have been imposed by the UN. The international community demands that the military government hand over power to the legally elected government and that serious differences be settled through the courts and by international mediation. The fear is that with the acquiescence of the military, the "Sons of Vanua" will begin killing and mutilating ethnic-Indians.

Guatemala 2010

The situation has deteriorated greatly since the overthrow of the legally elected Arzu administration in 2009 by a group of army officers led by Colonel Gomez Riodesangre. His stated reason for the coup was to purge the Marxist dominated establishment.

Riodesangre reactivated the defunct Civil Defense Patrols, numbering approximately 200,000. These local militias are mostly Mestizo and have the reputation of being very brutal with rural and non-westernized Amerindians. They are armed with assault rifles.

One of the first actions of the new regime was to expel MINUGUA from Guatemala (MINUGUA was the UN human rights watchdog organization in Guatemala that was first established in 1994). The UN General Assembly immediately imposed trade sanctions after this action.

Colonel Riodesangre also decided that the underdeveloped hinterlands of Guatemala needed to be reclaimed for agriculture. Pursuant to this policy Civil Defense Patrols have begun a forced evacuation of Amerindian people from the provinces of Quiche, Alta Verapaz, and Baja Verapaz. Murder, torture, burning villages and other atrocities accompany these brutal actions.

Some of the affected Amerindians, the Maya Achi people in Quiche under the leadership of Eduardo Estrella, have armed themselves and are resisting the Civil Defense Patrols. Their weapons (mostly old rifles and submachine guns) are being clandestinely smuggled into Quiche down the Ixcan River and probably via other routes by sympathetic Amerindian groups in Southern Mexico. This is known because the Guatemalan Army intercepted several arms shipments on the Ixcan. It is estimated that the armed Maya Achis number nearly 4,000.

Under Riodesangre the armed forces were increased from 31,000 to 60,000 by calling up most of the reserves. The Guatemalan Army is mostly Mestizo in its make up and is equipped with modern infantry weapons and some light armored vehicles.

The Civil Defense Patrols reportedly massacred some 500 Maya Achi people near the Rio Negro on February 15th 2010. This was followed by an attack by Maya Achi guerillas on a Guatemalan Army training camp resulting in the death of 53 new conscripts. These incidents have provoked Colonel Riodesangre into declaring martial law throughout Guatemala and ordering the previously uncommitted regular army to conduct sweeps of Maya Achi-inhabited areas of Quiche with the support of helicopters and Dragonfly attack planes flying out of Guatemala City and Flores. Their mission is to find and destroy the insurgents. During the conduct of operations, the Army is also providing fire support to the Civilian Defense Patrols in their mission to clear the provinces mentioned above.

One of the more worrying aspects of the operation is the fate of those Amerindians that are being forcibly evacuated. Intelligence reports that camps have been set up at Santa Cruz del Quiche, Coban and Salama. It is estimated that nearly 600,000 Amerindians have been deported to these camps and an unknown number murdered. It is already clear from the few survivors who managed to escape that those who refuse to leave their homes are usually killed

Iraq 2010

In 2007, the United Nations lifted the totality of sanctions and restrictions that had been imposed on Iraq for nearly 17 years. This came about after years of hard lobbying especially by Russia, China, and France. Iraq no longer has Northern and Southern no-fly zones and it is free to rebuild its armed forces.

Saddam Hussein is still President of Iraq and has not changed politically. One of his 1st major acts was to remilitarize Northern Iraq after many years of only limited control. Part of this policy was strengthening the pro-central government Kurdish Democratic Party, or KDP, for paramilitary operations against the Iranian-supported Barzani Kurds. The KDP is concentrated in Dahuk and Ninawa while the Barzani Kurds are concentrated in the Northeastern corner of Iraq in Arbil, Sulaymaniyah, and At Ta'Mim.

In May of 2008 the Iraqis sent two mechanized and one infantry division of the Republican Guard to bolster the KDP forces in Dahuk, the latter including 15,000 militia and 25,000 tribesmen. For nearly two years Iraqi and KDP forces have conducted low intensity operations against the Barzanis who are well armed with Iranian equipment and who are estimated to include 10,000 militia and 22,000 tribesmen. Nothing more ambitious has been done because Iraqi military equipment was largely unserviceable after so many years of sanctions. Barzani Kurds still control their sphere of influence described above.

By 2010 Iraq has largely rebuilt its armed forces through the purchase of Russian and Chinese weaponry. Its 375,000-man army has been completely re-equipped with modern Russian tanks, infantry fighting vehicles and helicopters. The Iraqi air force now boasts 350 modern combat aircraft including SU-31s, SU-25s and Shenyang F-10s (Chinese Mig-29s). Intelligence reports that Iraq is obtaining Chinese assistance to rebuild an effective ballistic missile capability. Although these weapons were partly donated as military aid from Russia and China, Saddam has used large amounts of his oil revenues to help pay for them. This was done at the expense of badly needed social and infrastructure programs for Iraq's civilian population.

Feeling more confident with his rebuilt armory, Saddam has decided to intensify operations and destroy the Barzani Kurds. Intelligence reports indicate that he plans full-scale invasion of the Barzani area with strong ground and air forces. The KDP is to follow the Iraqi army as it reconquers the three provinces and ethnically cleanse the Barzani Kurds. Intelligence reports that Saddam has baptized the operation "Northern Motherland" and it is supposed to begin in mid-March, 2000. The invasion is three weeks away.

Kosovo 2010

Despite efforts to establish and maintain order in the autonomous province of Kosovo ethnic violence and lawlessness remain a major threat to stability. Extended ethnic Albanian families (called "clans") and armed political factions have traditionally created strife that has been suppressed in the past by Ottomans, fascists, and Communists alike. This situation has been exacerbated by the lack of legitimate local government that has existed in Kosovo since 1999. With the new US administration, NATO pulled out of the former Yugoslavia in 2004. For several years, the UN sponsored International Police Force (IPF) helped the fledgling Kosovar government maintain at least a semblance of law and order. On December 31 of 2009 the last of the IPF pulled out of Kosovo.

The weakness of the Kosovar government now became apparent. Recent reports state that members of the disbanded Kosovo Liberation Army (KLA) led by General Flew control the city of Pristina and are engaging in criminal activity. The KLA is said to control fuel, food, cigarettes and prostitution in much of the Balkans. In addition, the KLA has a radical armed faction that wants to cleanse the province of all ethnic Serbian families. These KLA armed factions currently have 12,000 men under arms in 8 infantry battalions and 4 artillery battalions, although most support comes from KLA civilians not under arms. KLA justice is brutal: if an ethnic Serbian is caught and brought to justice before being killed, they will typically be tortured to death and then burned. The family will then suffer additional retribution from the KLA. This usually means death for the whole family. The modus operandi of the KLA is very similar to that of the Sicilian Mafia. That is to say if you kill one family member, you must kill them all.

Serbians who returned from refugee camps in the late 1990's have armed themselves with some small arms type, weapons but are not organized to defend against the KLA factions. Men from the clans form platoon and company size ambushes and launch occasional attacks against KLA strongholds in order to get weapons and ammunition. Intelligence reports that they number some 1,500 men. Former Yugoslav Army Colonel Sergey Malikoff is trying to unite these fighters.

General Flew wants to move all ethnic Serbs out of Kosovo in the next six-months and has stated he will kill any who are left in the province by early next year.

Since 2005, the Inca guerilla group known as the Atahualpa Revolutionary Movement, or MRA, led by Rascar Capac, has become a powerful and influential force in the Peruvian departments of Ucayali, Madre de Dios, Cusco, and Puno. Rascar Capac's goal is to create an autonomous Inca state. His movement has considerable grass roots support in the four above-mentioned provinces. These Incas (there are very few Mestizos or whites in this region) feel that they are treated badly by a racist central government. Capac has called for civil disobedience and already certain symbols of the central government, notably tax collection, no longer function.

There is a small, armed component to the MRA. Intelligence reports that it has been armed and trained by former Shining Path guerillas. An estimated 1,500 former Shining Path guerillas provide the backbone of the 3,000-man MRA paramilitary force. They have armed themselves with small arms from old Shining Path weapons caches. These forces are spread out over the four rebellious departments and Intelligence reports that rebel bases are located in Manu, the Alto Purus Valley, and near Azengaro.

On July 28, 2007, (Independence Day in Peru) the Government of President Toledo was toppled by a military coup instigated by Admiral Juan Grau. The stated reason for the coup was the widespread corruption and lawlessness that evolved with the Toledo administration since it took power in July 2001. The new regime emphasizes patriotism and catholic values. Grau has put into effect a program to re-establish the authority of the central government in all of the 24 departments that make up Peru, especially the rebellious departments of Ucayali, Madre de Dios, Cuzco, and Puno.

This new policy was put into effect with the declaration of martial law in the four provinces mentioned above. To help enforce martial law, Admiral Grau has activated a Mestizo peasant militia known as the Rondas Campesinas. The Rondas has 17,000 members, is armed with old Peruvian Army small arms and machine guns, and has been provided with trucks and jeeps for mobility. 6,000 Technical Police, the Peruvian 1st Airborne Division and the Peruvian Air Force back up this paramilitary force. The main mission of this combined force is the pacification of the four departments and the elimination of the MRA.

Peru's armed forces consist of: a 75,000-man infantry based army; a 15,000-man air force with 96 serviceable combat aircraft and bases in Tacna, Juliaca, Chorillos, and Pucallpa; a 25,000-man ocean-going navy including 6 modern diesel-electric submarines, 2 older ex-Dutch cruisers and 4 destroyers and frigates; a 77,000-man national police force.

Since February of 2009, government forces have pursued relatively low-intensity operations consisting sweeps to catch the MRA and air strikes on suspected rebel bases. In September of 2009, the MRA ambushed a Rondas convoy on the Cuzco-Puerto Maldonado road killing 150 out of 200 Rondas. This was followed by Ronda reprisals on the Inca communities of Quillabamba and Macusani. There have been many reports of atrocities committed by the Rondas in these attacks. Intelligence reports that the government is planning a large-scale reprisal operation in Cuzco and Puno combined with an ethnic cleansing to rid the region of all undesirable elements. The beginning of this operation is set for November 15, 2009, that is to say within 30 days.

Rwanda 2010

The situation in Rwanda has been unstable for over a decade with over a million unsettled Rwandans (mostly Hutus) and a continuing insurgency in the Northwest by the mostly Hutu Rwandan Patriotic Army and remnants of the Interahamwe (Hutu militia implicated in the 1994 genocide). These forces number close to 25,000 and are equipped with small arms and some light mortars. They are led by former Rwandan Army General Theophile Anamunga and are supported and supplied by the Democratic Republic of the Congo.

It is now July of 2010. President Pasteur Bizimunga of Rwanda is having difficulty staying in power. After three years of bad coffee harvests combined with a big drop in coffee prices the one-crop Rwandan economy has been shaken. As well as the economic problems, the Hutu insurgency has picked up steam and Interhamwe militia forces recently entered the Byumba prefecture. This has caused unrest among the population of Kigali as they are now faced with economic misery combined with rebel forces less than 50 miles from the capital.

A desperate Bizimunga has declared a state of emergency and martial law. The Gendarmerie has begun arresting the Hutu inhabitants of Kigali and trucking them to Kicukiro where the Gendarmerie and the United Tutsi Militia or MUT are building a concentration camp. The paramilitary Gendarmerie numbers 7,000 while there are 1,500 fighters in the MUT. Over 70,000 Hutus have been rounded up and are being held in very poor conditions at Kicukiro. Many are sick and are dying due to a total lack of sanitary facilities.

With the RPA and Interahamwe forces getting closer to the capital President Bizimunga has issued the rebels an ultimatum. He declared that if rebel forces advanced beyond the Rushashi/Mbogo/Murambi line, the Gendarmerie and MUT would commence executing the now more than 150,000 Hutus incarcerated in Kicukiro Concentration camp. The whole of Rwanda's army consisting of 15 infantry battalions, one battalion of artillery, and one mechanized infantry regiment is holding the Rushashi/Mbogo/Murambi line. Intelligence reports that Bizimunga is desperate and will carry out his threat. Intelligence also reports that the Rwandan army is in increasing difficulty and may hold for only two more weeks.

Sierra Leone 2010

In November of 2001, after several years of unremitting chaos, the United Nations imposed a mandate over Sierra Leone. A coalition consisting of the United Kingdom, India and Nigeria was empowered to occupy Sierra Leone for 4 years, disarm the warring parties, capture and bring to trial war criminals, and restore order and stability. In this, the coalition was largely successful. In August of 2004 national elections were held and Alexander Mosaki of the National Renewal Party was elected president of the Provisional Republic of Sierra Leone. Mosaki is an important Mende tribe elder.

It seemed that this experiment in nation healing was going according to plan. Government services were now working smoothly, schools were re-opened, and hospitals were functioning and well supplied. The only discordant note was the mass migration of nearly 100,000 Temne tribesmen to southern Guinea. This group, under the leadership of Friday Banko, preferred being refugees to living under Mende rule.

In November 2005, the coalition pulled out as planned. The result was better than could have been hoped for. Sierra Leone was once again considered a safe trading center for West Africa. Some of the first to exploit these new conditions were the diamond merchants. With the market price for diamonds at a record high Sierra Leone began earning significant foreign exchange.

National defense was insured by the creation of a British-trained National Self-Defense Force. This force consisted of six 500-man infantry battalions armed with small arms and light mortars and equipped with trucks and Land Rovers for mobility. The new naval component was equipped with three new British-made coastal patrol boats displacing 200 tons each and armed with two 40mm Bofors cannon. The only aircraft in this force consisted of two Westland Super Puma transport helicopters. The army base, navy port and two paved airfields of the country are located in Freetown.

Until the middle of 2008 the Mosaki administration was popular and prosperity seemed assured. However, it was at this time that allegations of corruption were made against the Mosaki government. Apparently, some ministers and members of Mosaki's family were embezzling large amounts of money from Customs and Excise. There were also reports of them smuggling diamonds out of the country. Public support fell dramatically and members of parliament called for a thorough investigation. The results of the investigation were to be revealed on March 1, 2010. On February 15, 2010 President Mosaki, accompanied by cabinet ministers and members of his family, fled to Liberia with an estimated 13,000,000 USD in foreign exchange and diamonds.

With the departure of the entire government, chaos took hold in the streets of Freetown. Colonel Johnny Bubinga, chief of the National Self-Defense Force or NSDF, deployed his forces to quell the unrest. Meanwhile, on March 3, 2010, Friday Banko, leading a force of 3,500 Temne tribesmen christened the "Justice and Freedom Front", or JFF, crossed the border into Sierra Leone calling for a new beginning. His force took Kambia and Mango on March 3, 2010. Intelligence and rumor reported that his fighters were rounding up and executing all Mende men. There have been no reports on the fate of the women and children.

With the news of this invasion two Temne battalions of the NSDF abandoned their posts and headed north to join Banko. Colonel Bubinga, a true believer in the new Sierra Leone, declared himself President and proceeded to consolidate control over the “Western Area” around Freetown. His force was too weakened to deal with Banko’s JFF, which had by then taken Port Loko. Bubinga appealed to the International community to help prevent the JFF from murdering all the Mendes of the countryside.

YEMEN 2010

Jamhiyya tribesmen of the northern highlands under the leadership of the Zaydi (Shi'a) Imam Mohamed Abdullah Saleh, practiced a radical fundamentalist form of Islam similar to that of the Taliban in Afghanistan. Mohamed Abdullah sought the overthrow of the secular central government and the transformation of Yemen into a fundamentalist Islamic republic.

In 2001 at the head of his Jamhiyya tribal levies and with a large proportion of the regular army (most of the Yemeni army consists of Jamhiyya tribesman from the northern highlands), Mohamed Abdullah entered Sanaa and toppled the central government, establishing a fundamentalist Zaydi Islamic regime throughout Yemen. The goal was to set up a completely insular Islamic state inhabited by racially pure Arabs. This regime was condemned by the UN for their brutal takeover and the Security Council imposed a trade embargo on all arms and strategic goods.

Although for most northerners this made little difference, the impact was great on the more secular and commercially oriented people concentrated around Aden and in the isolated Hadhramawt. These people, who are mostly merchants, have traditionally subsisted on their trade with the outside world. The Hadhramis, although Muslims, are ethnically close to southeast Asians and are generally disliked by the ethnic Arabs. Up to 2007, the people of Aden and the Hadhramis were tolerated by the Zaydi regime because of the valuable foreign exchange they brought into Yemen. However, recent discoveries of plentiful offshore petroleum helped convince Mohamed Abdullah that the southern traders were no longer useful and that the time had come to convert or eliminate them. For those around Aden religious re-education camps were established and thousands of Adenites were incarcerated. To implement his plans Mohamed concentrated most of his army around Aden. The re-education camps located in Madinat ash Sha'b, Labij, Zinjibar and Shaykh 'Uthman are guarded and run by 20,000 Jamhiyya levies. For the ethnically non-Arab Hadhramis, Mohamed Abdullah made different plans.

The Hadhramis, alarmed at the treatment of their colleagues in Aden, appealed to the international community for protection. The international community led by the USA has imposed a stricter regime of sanctions on Yemen. More radical Hadhramis have established a civil defense militia. They are mostly armed with farming tools and number nearly 3,000.

Recent intelligence reports indicate that the Zaydi regime is purchasing chemical nerve agents to equip the warheads of their old Scud ballistic missiles. Apparently very few Yemeni air force planes are fit to fly due to bad maintenance and no spare parts. Reliable sources say that Mohamed Abdullah plans to punish the Hadhramis with chemical weapons of mass destruction. As the Zaydi army has no presence in that isolated part of the country (nearly 1,000 miles from Aden), Mohamed Abdullah plans to bombard the towns of the Hadhramawt with nerve gas tipped Scuds.

Satellite reconnaissance has determined that 2 of 6 known Yemeni Scuds were moving on their transporters outside a hangar at Bayhan al Qisab airport. It is suspected that the nerve agents are being produced at one of two petroleum refineries in Aden and Ma'rib. HUMINT reports indicate that the WMD preparations will be completed in three weeks. It is feared that Mohamed

Abdullah will unleash his rain of death on the Hadhramawt as soon as the chemical warhead Scud missiles are ready.



**Coercion Working Group
Appendix C-3**

**Headquarters Effectiveness
Assessment Tool (HEAT) indicators of
command and control quality**

**Headquarters Effectiveness
Assessment Tool (HEAT)
Indicators of Command and Control
Quality**

Top-Level Metrics

- Monitor
- Understanding
- Courses of Action
- Collaboration
- Decision
- Directive
- Inquiry
- Response
- Coordination
- Report

Monitor

- Monitor data will contain current enemy and friendly unit locations, type, strength, status, movement, and logistics. These data are always presented as fact, although it may be in error. Data within each Monitor are scored individually for their correctness.
 - Subject of Data
 - Blue forces
 - Red forces

Monitor (cont.)

- **Type of Data**
 - Unit location – grid coordinates/ proximity to checkpoint
 - Type – armored, mechanized, infantry, artillery, air, irregular, support (logistics, medical, etc.)
 - Strength – as a percentage of original / numbers observed
 - Status – defending/attacking
 - Movement – direction, speed
 - Logistics – whether a unit is in supply or not
- **Correctness of Data**
 - Correct - data in monitor agrees with current ground truth
 - Incorrect - data in monitor does not agree with current ground truth

Understanding

- Understandings will pertain to an individual's (or group of individuals') perception of a situation based upon the facts at hand concerning the environment and the individual's experience in similar situations. Because all information concerning the environment is not available, more than one perception can be expressed or held at a given time. An understanding can address past, current or expected situations. The key to recognizing an understanding is that a briefing or discussion is centered on the environment and involves interpretation or judgment.

Understanding (cont.)

- Timeframe for Understanding (Code Hours when Relevant)
 - Past
 - Present
 - Future
- Correctness of Understanding
 - Correct - agrees with current/future ground truth
 - Not Incorrect - contains correct element(s), but includes additional element(s) which don't agree with current/future ground truth
 - Incorrect - does not agree with current/future ground truth

Generation of Alternative Courses of Action

- Given an understanding of the military situation, the headquarters develops a set of alternative actions. These alternatives involve what can be done to alter the situation understood to exist. Options considered are always in the form of what friendly units could or should do to create a desired situation or react to a change or anticipated change in the environment (enemy maneuver, etc.).
 - Number Generated
 - Number of Participants (Roles = Individuals)

Evaluation of Alternative Courses of Action

- Evaluation of courses of action always involve a statement of what the situation will be upon completion of a given course of action. Such predictions are sometimes implied, for example “in order to stop the enemy’s advance at Phase Line Alpha, we will...” The implied prediction is that the advance will successfully be stopped at Phase Line Alpha if this course of action is followed.
 - Number Evaluated
 - Duration of Evaluation
 - Correctness of Evaluation (if played out)

Collaboration

- Metrics for collaboration address team products, processes, and coherence.
- Product metrics concern the quality and timeliness of the collaboration product and the efficiency with which the product is produced.
- Process metrics concern how well the team functions as a team.
- Coherence metrics measures the team’s cognitive coherence and alignment.

Collaboration (cont'd)

Product Metrics

- Timeliness of product
- Is the product of collaboration useful to the commander

Collaboration (cont'd)

Process Metrics

- Time after information is needed from other team members that is provided
- Time required by product provider to adjust product as requested by recipient
- Time needed to disseminate messages
- Percent of messages received that are relevant
- Number of instances where problems were not recognized prior to problem impacting team product
- Time required by team to modify tasks to adapt to new circumstances
- Time needed to disseminate the revised plan

Collaboration (cont'd)

Team coherence metrics

- Similarity of interpretation of commander's intent among team members
- Number of centers of gravity that all team members identify; number that some but not all team members identify
- Accuracy of team member's knowledge of roles and responsibilities of other team members.
- Accuracy of identification of team members able to obtain specified information elements

Decision

- Decisions are made on the basis of predictions. They take the form of a "plan" to be implemented, which includes missions, assets, boundaries, and a schedule. Success is determined by whether the mission was accomplished. Whether the commander allows a subordinate commander to choose a course of action will be recorded. If the decision represents a departure from the pre-exercise plan based on mission, assets, schedule and boundary criteria, it will be coded as a Variation from Intent. Decisions are made from a choice of actions, or may be contingent based upon pre-specified conditions. Decisions are either proactive (acting in anticipation of future needs, problems, changes), reactive (primarily to red moves), or a combination of both. Speed of decision from the original stimulus, characterized by monitors, reports or understandings, is also measured.

Decision (cont.)

- Success of Plan
 - Successful
 - Unsuccessful
- Delegation of Authority?
 - Yes
 - No
- Chosen from Courses of Action, or Contingent
 - Course of action
 - Contingent

Decision (cont.)

- Consistency with Commander's Intent
 - Consistent
 - Variation
- Proactive, Reactive, or Combination
 - Proactive
 - Reactive
 - Combination
- Speed of Decision
 - Was Collaboration used?
 - Collaboration
 - No Collaboration

Directive

- Command issued by blue staff in the name of the commander. Quality of directive can be measured both by agreement with the Decision, and by the number of clarifications needed.
 - Agreement with Decision
 - Agrees
 - Doesn't agree
 - Number of Clarifications Needed for Directive

Inquiry

- Inquiries are requests for information between a staff and subordinates. The direction of the inquiry will be recorded, as well as whether the requested information was already displayed and whether the inquiry was answered.
 - Direction of Inquiry
 - Staff to subordinate
 - Subordinate to staff
 - Was Information Already Displayed?
 - Yes
 - No
 - Was the Inquiry Answered?
 - Yes
 - No

Response

- Responses are answers to specific inquiries. How quickly, how completely, and how correctly the Inquiry was answered are recorded.
 - Time between Inquiry and Response
 - Completeness of Response
 - Complete
 - Incomplete
 - Correctness of Response
 - Correct - agrees with current/future ground truth
 - Not Incorrect - contains correct element(s), but includes additional element(s) which don't agree with current/future ground truth
 - Incorrect - does not agree with current/future ground truth

Coordination

- Coordination refers to information passed between the functional cells of the blue force in order to facilitate the implementation of a plan. Such interaction deals with the “what” in problem solving. Whether all appropriate actors are involved in the coordination, and whether the coordination is concluded, will be noted.
 - All appropriate/relevant actors involved?
 - Yes
 - No
 - Concluded?
 - Yes
 - No

Report

- Reports (i.e. SALUT, Alerts) may concern monitoring, understanding or prediction data. However, reports are contained in communications between elements in the environment (subordinate commanders, etc.) and the commander rather than to others within the command post. The key to recognizing report data is communications to other commanders that contain monitoring, understanding, and/or prediction data. Elements of information within reports are scored individually for correctness according to their type (i.e. monitor, understanding).
 - Nature of Report Element
 - Voluntary
 - Scheduled/Required

Report (cont.)

- truth Subject of Report Element
 - Blue forces
 - Red forces
 - Both
- Type of Report Element
 - Monitor
 - Understanding
 - Prediction
- Correctness of Report Element
 - Correct - agrees with current/future ground truth
 - Not Incorrect - contains correct element(s), but includes additional element(s) which don't agree with current/future ground truth
 - Incorrect - does not agree with current/future ground

Back-Up Slides

Collaboration

Metrics for collaboration address team products, processes, and coherence. Product metrics concern the quality and timeliness of the collaboration product and the efficiency with which the product is produced. Process metrics concern how well the team functions as a team. Coherence metrics measures the team's cognitive coherence and alignment. Studies of team effectiveness have demonstrated that teams with high cognitive coherence function well as a team and create high quality products efficiently.

Product metrics are the bottom line metrics. A team that cannot create a high quality product efficiently is not an effective team, even though it may exhibit high quality processes and a high level of coherence. Because product metrics are not specific to collaboration, however, they are not discussed further here.

Collaboration (cont'd)

The process and coherence metrics described below are selected for their relevance to the types and teams to be investigated in the IS exercise. These assume teams of about six people will plan and execute a military mission. Team membership and roles will be stable during the evaluation, team objectives will be well defined, team members will be familiar with their assigned tasks, information will be readily available if asked for, team members can work independently most of the time, and team member tasks will be moderately independent. If these assumptions are not correct, then the metrics listed below would need revision

These metrics also assume that data collectors will be permitted to question participants only during specified debriefing sessions held during designated breaks in the game.

Collaboration (cont'd)

Process Metrics

Metrics for synchronization

- Time after information is needed from other team members that it's provided
- Time required by product provider to adjust product as requested by recipient

Metrics for sharing information

- Time needed to disseminate messages
- Fraction of messages received that are relevant

Collaboration (cont'd)

Process Metrics (cont'd)

Metrics for problem detection--the ability of the team to spot problems in time to react

- Number of instances where problems were not recognized prior to problem impacting team product
- Average delay in noting problems after cues to problem were available. Considers only problems whose recognition requires combining cues received by different team members.

Metrics for adapting to new circumstances

- Time required by team to modify tasks to adapt to new circumstances
- Time needed to disseminate the revised plan

Collaboration (cont'd)

Team coherence metrics

Metric for efficient use of expertise

- Frequency of cases where expertise existed on the team and was needed but was not tapped.

Metrics for shared knowledge

- Similarity of interpretation of commander's intent among team members
- Fraction of adversary forces on which all team members agree on location, size, and identity.
- Fraction of friendly forces where all members agree on location and status
- Number of centers of gravity that all team members identify; number that some but not all team members identify

Collaboration (cont'd)

Team coherence metrics (cont'd)

- Fraction of planned tasks that all team members correctly identify
- Fraction of contingencies that all team members correctly identify
- Fraction of conditions for implementing contingencies that all team members identify

Collaboration (cont'd)

Team coherence metrics (cont'd)

Metrics for common ground

- Accuracy of team member's knowledge of roles and responsibilities of other team members.
- Accuracy of identification of team members able to obtain specified information elements
- Accuracy of identification of team members' needs for specific kinds of information



Coercion Working Group

Appendix C-4

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MORS Workshop on
Advancing C4ISR Assessment
Coercive Operations Working Group
Final Report
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Appendix C-5

**Advancing C4ISR Assessment
Workshop:
Notional Urban Tradeoff Study
Study Plan**

(Note: This notional study plan is a product of the Urban Warfare Working Group in the above workshop. It represents the member's suggestions only — it is NOT an actual government study plan.)

October 2000

1 INTRODUCTION

1.1 Purpose of Study Plan

The goal of the Military Operations Research Society (MORS) Workshop on Advancing C4ISR Assessment is to ameliorate deficiencies that presently restrict our abilities to analyze issues related to C4ISR performance and effectiveness. Toward this goal, several working groups will uncover specific strengths and weaknesses through development of notional study plans.

This study addresses Urban Warfare investment tradeoff decisions both within C4ISR-related Joint Mission Areas (Information Superiority, ISR, Communications and Computer Environment), and between C4ISR and other Joint Mission Areas (Precision Engagement and Dominant Maneuver). The remainder of this plan considers this notional problem.

This plan highlights study issues, defines the objectives that will address these issues, and outlines the approach, actions, and milestones to achieve study objectives. The study plan will serve as the coordinating mechanism for various government organizations and contractors participating in this effort and will provide visibility for senior leadership to exercise timely oversight.

Because of the broad range of potential urban operations and conditions, this study cannot examine all cases explicitly. Therefore, an important purpose of this plan is to ensure the best use of prior studies and to direct new analysis toward the remaining areas of greatest value-added to decision makers. This purpose places emphasis on identification of bounding conditions and important general relationships between information and urban outcomes. It requires an analysis plan with significant feedback (of analytical results and from decision makers) and recursion.

Given the current state of data and methodology for analysis of C4ISR systems in urban environments, this plan does not address the full range and depth of all essential issues. To compensate, this study will use expert elicitation and other qualitative techniques to augment quantitative performance, effectiveness, and cost analysis. This plan will identify anticipated data sources and sources of expert judgments to ensure timely peer review.

1.2 Background

The Secretary of Defense, Defense Science Board, and others have identified the increasing importance of urban operations. In response, this study was directed by Senior OSD leaders to ensure that key resource decisions within the current PPBS cycle can be taken in light of their potential impact on Joint Urban Operations.

1.3 Study Purpose

This study will address the central questions,

What potential C4ISR investments support Precision Engagement and Dominant Maneuver requirements in urban operations?

What C4ISR investments may trade or substitute for Precision Engagement weapons/platforms and Maneuver Forces in urban operations?

Derived from this central question, essential issues include:

- How does the wide range of possible urban missions affect analysis of C4ISR?
- What are the important objectives and decisions for urban operations? (How do they differ for Major Theater War, Operations Other Than War, Peacekeeping, and other operations? At Strategic, Operational, and Tactical levels?)
- What are the cause-and-effect relationships between objectives in urban operations (e.g. reduction of enemy force structure or specific threats dispersed in city) and information, strike, and maneuver capabilities?
- Define metrics to describe urban operational objectives, information, strike and maneuver performance.
- What are the most important unsatisfied requirements for C4ISR, Precision Strike, and Dominant Maneuver in Urban Warfare?
- How should the relative allocation of C4ISR capabilities for urban operations differ from allocation in open terrain?
- For selected cases, how does the quantity of strike (or maneuver) forces needed to achieve a given objective vary with the quantity, quality, and timeliness of information?
- What is the value of negative information (e.g. with sufficient Intelligence Preparation of the Battlefield, can important inferences be made regarding adversary courses of action)?
- What is the value of urban taxonomies (e.g. classes of identification-friend-or-foe, urban terrain types, indications and warning/threat levels)?

1.4 Study Scope

1.4.1 Urban Scenarios Only

The DPG emphasizes the importance of the urban environment against an adversary seeking an asymmetric advantage and directs that the U.S. military “develop an integrated approach that optimizes key warfighting capabilities for future operations on urban terrain.” This analysis will not consider the relative importance of urban vice non-urban terrain. This analysis assumes that urban scenarios are sufficiently important to decision-makers to justify the implementation of cost-effective urban C4ISR investments.

1.4.2 Range of Military Actions

This study will address C4ISR requirements, current/programmed capabilities, and shortfalls for warfighting and Military Operations Other Than War/Military Operations on Urban Terrain (MOUT).

Case studies will explore selected phases of at least two urban scenarios. Set in and around a major urban area in Southeast Asia, the first scenario will examine requirements, capabilities, and shortfalls during a Major Theater War. The most stressing requirements for urban C4ISR may likely occur during operations to gain control of a major city held by an adversary.

Set in and around a large urban area in a relatively poor nation, the second scenario will address military operations other than war such as humanitarian assistance and noncombatant evacuation operations (e.g. Sub-Saharan Africa). The short timeline, limited resources, relatively restrictive rules of engagement, and potential for mission creep are stressing elements of this scenario.

Historical research will address concepts of operations, Essential Elements of Information (EEIs), C4ISR systems performance and shortfalls from a wider range of urban actions and environments. Pertinent results will be used to identify scenario-specific results that appear to differ from the historical record. However, we anticipate that the historical record may prove to be incomplete and somewhat anecdotal.

This study will identify the potential range of selected urban conditions to compare with the specific conditions used in this study. Any inferences that appear to apply uniquely to study scenarios will be noted. A tentative examination of the range of selected Conditions for Joint Tasks in the Joint Chiefs of Staff Universal Joint Task List suggests that the first study scenario is near most stressing for about 50% of these conditions (Table 1). The less stressing conditions for C4ISR are mostly related to the mature nature of the theater. Considering both scenarios, about 85% of the most stressing conditions will likely be addressed in at least one scenario.

1.4.3 Address C4ISR Impact on Operational Objectives

Any urban C4ISR vignettes and requirements used in this analysis will have demonstrated linkage to strategic or operational level objectives and tasks.

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Table 1. Study Scenarios Compared With Range of Selected Urban Conditions

	UJTL Condition	Range of Condition	MTW-Seoul	NEO-Africa
1.1.1.1	Terrain Relief	High (>500 ft) Very Low (<10 ft)	Low	Low
1.1.3.1	Urbanization	Significant (>500K) Minor (<50K people)	Significant	Significant
1.1.3.2	Significant Civil Structures	Numerous (urban) Some (suburban)	Numerous – Some	Numerous – Some
1.4.1.1	Orbit Density	Low (very few objects) High (many objects)	High	Low
2.1.1.2	Pre-Existing Arrangements	No Strong (e.g. NATO)	Strong	No
2.1.1.4	ROE (divergence from published J3 standard)	Multinational U.S.	U.N.	Multinational
2.1.3	Mission Preparation	Outline/No Completed	Completed	Outline/No
2.1.4	Theater Dimensions	Massive Small (a joint ops area)	Medium	Small
2.1.4.2	Theater(s)	More Than Two One	One	One
2.1.4.3	Joint Operations Area	Very Small (<100K km2) Very Large (>3M km2)	Large	Moderate
2.1.5	Time Available (to complete mission phase)	Minimal (minutes-days) Long (weeks-months)	Short (hr-day)	Short
2.1.5.1	Lead Time	Minimal Long	Short – Long	Short
2.2.3	Forces Allocated	Marginal (less than plan) Strong (exceeds plan)	Strong	Moderate
2.3.1.4	Pre-Existing Command	No (ad hoc) Strong (functioning)	Strong	No
2.4.2	Intelligence Data Base	Negligible (little current) Abundant (multi-source)	Marginal	Marginal
2.4.3	Theater Intelligence Organization	Immature Mature	Mature	Immature
2.4.5	Certitude of Data	Little or No (<25%) Absolute (100% confident)	Moderate	Little or No
2.5.1.5	Entry Capability	Strongly Opposed Unopposed	Unopposed	Unknown
2.6.5	Target Mobility	High (dwell time in min) Very Limited/Fixed	Very Limited	High
2.6.7	Collateral Damage Potential	High Moderate	Moderate	High
2.9.2	Threat Form	Unconventional/WMD Conventional	WMD – Conventional	Unconventional
2.9.5.1	Threat Land Force Size	Overwhelming Low	Large	Low
2.9.5.2	Threat Naval Force Size	Overwhelming Low	Low	Low
2.9.5.3	Threat Air Force Size	Overwhelming Low	Moderate	Low
3.1.1.1	Domestic Public Support	Negative Full	Limited	Unknown
3.1.2.1	Major Power Involvement	Active No	Limited	No
3.1.3.1	Number of Crises	Large (>2) Small (1)	1	1
3.3.1.6	Civil Unrest	Extensive (weekly) Little (yearly)	Extensive	Extensive
3.3.2.2	Refugee Congestion	Severe (stoppages) Negligible	Moderate	Severe
3.3.2.3	Refugee Care Responsibility	Significant (drain forces) Negligible	Moderate	Unknown
3.3.2.4	Refugee Relocation Effort	Significant (drain forces) Negligible	Moderate	Unknown

1.5 Study Premises

1.5.1 Past Urban Operations Experiences Will Remain Relevant to Future Operations

For the period examined in this study, lessons learned from U.S. urban operations in Haiti, Panama, and Somalia and Russian operations in Chechnya will remain relevant. With less certainty, other urban operations such as Hue City and Stalingrad may also remain relevant.

1.5.2 U.S. Forces in Urban Operations Will Operate as Part of A Multinational Force

U.S. forces will normally be part of a multinational coalition when conducting urban operations. During these operations, urban task forces may or may not be U.S. only.

1.5.3 Urban EEIs Significantly Different from Those for Open Terrain

The unique nature of urban terrain prompts the hypothesis that the quantity, quality, and/or priorities of urban EEI's will be significantly different from those in non-urban scenarios.

1.5.4 C4ISR Systems Less Effective in Urban Terrain

Much of the urban battlespace is inside structures or under the ground. Urban terrain offers many more hiding places with obvious consequences for most collection systems. Urban terrain will restrict line-of-sight, especially into urban canyons, subterranean passages, etc.. Target disposition and movement choices are unique, with impact throughout the TPED process. Clutter, objects similar in nature to the intended targets of ISR, may be more prevalent than the targets themselves. This prompts the hypothesis that almost all important current and planned C4ISR systems will be significantly less effective in some urban terrain.

1.5.5 May Have to Compensate with HUMINT

Small units and HUMINT will be used to compensate for the anticipated loss in other C4ISR system performance. However, an environment of U.S. information inferiority in this domain is not unlikely.

1.5.6 Terrorism Will Be a Major Concern

Directed at U.S. forces, noncombatants, or key infrastructure, terrorism will be a major concern during urban operations. U.S. forces will be tasked to mitigate this threat.

1.5.7 U.S. Military Will Have Certain Homeland Defense Responsibilities

In the future, U.S. military may be called upon to perform certain operations in U.S. cities as part of Department of Defense Homeland Defense responsibilities. If these operations occur concomitantly with deployed urban operations, they may affect the availability of high demand, low-density assets.

1.6 Key Assumptions and Data

The following lists key study assumptions and data sources:

Scenarios used in this study will be consistent with current Defense Planning Guidance and annexes.

- (1) Urban doctrine and concepts of operation will be consistent with Draft Joint Publication 3-06, "Doctrine for Joint Urban Operations".
- (2) Additional assumptions regarding scenarios and threat or doctrine and concepts of operation will be approved by the Study Oversight Group.
- (3) Standard descriptions of urban tasks (*Universal Joint Task List* and Service Task Lists) and information requirements (*Urban Generic Intelligence Requirements Handbook*) will be used. Additional information requirements may be developed or refined as needed to address detailed vignettes.
- (4) Current and programmed C4ISR architectures will be predicated on plans in the current FYDP.
- (5) Additional assumptions regarding C4ISR, Precision Engagement, and Dominant Maneuver performance, system characteristics and/or cost will be consistent with the following studies . . .

1.7 Objectives

This study will:

- Objective 1: Select and define baseline urban scenarios and excursions.
- Objective 2: Define the important objectives and decisions (Blue and Red) for urban operations in these scenarios
- Objective 3: Identify EEIs and IERs required to support selected elements of these urban operations.
- Objective 4: Describe the cause-and-effect relationships between objectives in selected urban operations and C4ISR, Precision Strike, and Dominant Maneuver capabilities
- Objective 5: Describe current and programmed force structure, systems, and C4ISR architectures available for selected urban operations.
- Objective 6: Estimate the impact of C4ISR, strike, and maneuver performance on effectiveness in selected urban operations.
- Objective 7: Identify potential tradeoffs between Precision Strike and Dominant Maneuver force levels and C4ISR information for selected urban operations and objectives
- Objective 8: Identify lessons learned and potential operations research needs to improve subsequent assessments.
- Objective 9: Synthesize a final product for use by OSD Senior leaders. Complete final briefing within 6 months. Complete final report, including coordination and final editing within 9 months.

1.8 Approach

This study will follow a modified version of the former Land and Littoral Warfare Joint Warfighting Capabilities Assessment (LLW JWCA) (now Dominant Maneuver) Joint Military Operations on Urban Terrain (MOUT) Assessment study plan. Up to three seminar/wargames will be used to focus and build consensus for quantitative analyses: Seminar/wargames will be used to: (1) prioritize and validate key decisions and objectives and associated C4ISR requirements in urban operations; (2) validate and prioritize C4ISR shortfalls; and (3) and consider potential solutions and tradeoffs. Each seminar/wargame will focus on one of these objectives and consider all study scenarios. The wargames will be supported by prior research/surveys and focused quantitative analysis. Quantitative analysis will use the most appropriate data and methods available as identified by the study team in consultation with MORS, the LLW JWCA Urban Working Group, and other sources. These include but are not limited to: (1) Joint Conflict and Tactical Simulation (JCATS) - urban operations and effectiveness; (2) ISR JWCA modeling and simulation suite - ISR performance in complex terrain; (3) Network Warfare Simulation (NETWARS) - communications in complex terrain. If validated urban data and models emerge during the study, greater emphasis may be placed on quantitative methods. See sections 3 and 4 for discussion of the study approach in greater detail.

1.9 Study Products

Study products will include a final written report for use by OSD Senior leaders. The final report will address the objectives presented in section 1.7 and provide supporting information. Interim and final briefings will present and justify study findings.

Table 2. Study Products

1a	Two scenario descriptions (approved by Oversight Group for study use).
2	Selected courses of action, important objectives and decisions (based on appropriate Joint urban doctrine and concepts of operation, approved by Oversight Group for study use).
3	Identification of selected Essential Elements of Information (EEIs) and Information Exchange Requirements (IERs) to support objectives and decisions for urban operations.
4	Influence diagrams or equivalent descriptions of cause-and-effect relationships between objectives in selected urban operations and C4ISR, Precision Strike, and Dominant Maneuver capabilities.
5	Description of current and programmed C4ISR architecture and capabilities available for urban scenarios.
6a	Description of case studies for quantitative analysis of impact of C4ISR, Precision Strike, and Dominant Maneuver for selected urban objectives.
6b	Run Plans for effectiveness (JCATS), C4ISR (ISR JWCA model suite, NETWARS), and other models and simulations
6c	Results showing impact of C4ISR, Precision Strike, and Dominant Maneuver capabilities on ability to meet selected urban objectives.
6d	Prioritized urban EEIs and IERs (validated in wargame, revised after CINC review).
6e	Identification of prioritized unsatisfied C4ISR requirements (EEIs and IERs) for selected urban operations.
7	Description of C4ISR capabilities in terms of equivalent Precision Strike and Dominant Maneuver forces for selected urban operations.
8	Lessons learned and recommendations for operations research and other improvements for subsequent assessments
9a	Draft documentation of up to three seminar/wargames.
9b	Final and interim study briefings.
9c	Final study report (will document study findings and methodology and include at least two drafts in addition to the final version)

The final report and briefing will be submitted to OSD Senior leaders. Interim and draft products will be provided to the study Oversight Group as they become available prior to final disposition. As appropriate, interim study products will be available on-line for Joint Staff and OSD Urban Working Groups, CINC, Service, and Agency review.

2 ELEMENTS OF ANALYSIS

For each of the study objectives, essential elements of analysis provide a breakdown of the associated tasks.

2.1 Objective 1: Select and define baseline urban scenarios and excursions.

- Task 1.1 Identify range of potential urban scenarios and characteristics of the military/physical/civil environment that impact urban decisions and objectives and C4ISR, Precision Engagement, and Dominant Maneuver requirements and capabilities.
- Task 1.2 Develop and prioritize baseline scenario and excursions to investigate urban C4ISR, Precision Engagement, and Dominant Maneuver requirements and capabilities.
- Task 1.3 Describe elements of friendly force that will participate in baseline scenario and excursions.
- Task 1.4 Describe friendly operational concept for baseline scenario and excursions.
- Task 1.5 Describe threat order of battle, capabilities, and operational concept for baseline scenario and excursions.
- Task 1.6 Describe selected conditions of urban environment in baseline scenario and excursions required for C4ISR, Precision Engagement, and Dominant Maneuver performance estimation (modeling and simulation).

The Urban Scenario and Threat Sub panel will address this objective. The first study scenario will be based on the LLW JWCA Urban Working Group MOUT Seminar/Wargame (29 Sept-1 Oct 98) module “*Offensive Operations to Regain Complete Control of Seoul*” or similar Major Theater War scenario. The sub panel will refine scenario for detailed C4ISR, Precision Engagement, and Dominant Maneuver analysis. The first level of detail includes information required to support conferences and seminar/wargames, to prioritize information requirements (EEIs and IERs), identify shortfalls, and consider solutions. The higher level of detail includes characteristics of the urban environment and threat CONOPS (e.g. lay down and movement) needed for quantitative performance and effectiveness analysis. (*Task 1.2*)

The sub panel will select and refine a second, Somalia-like scenario in Sub-Saharan Africa or equivalent smaller scale contingency. The scenario may include selected elements based on the LLW JWCA Urban Working Group MOUT Seminar/Wargame modules: Noncombatant Extraction; Humanitarian Assistance/Disaster Relief; and Transition. (*Task 1.2*)

The sub panel will request CINC input regarding “worst case” and “most likely” urban scenarios circa 2010 to verify the scenarios listed in this plan. (*Task 1.2*)

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Current and planned (end of FYDP) ISR architectures will be based on the recent J2 "*Recce 2010 Study*" or equivalent. (Task 1.3). The overall friendly concept of operations (CONOPS) will be refined from JP 3-06, *Doctrine for Joint Urban Operations*. C4ISR, Precision Engagement, Dominant Maneuver and other CONOPS will be derived from appropriate sources as needed. (Task 1.4)

If feasible, tentative threat CONOPS, capabilities, and behavior will be extrapolated for urban conditions from existing data. All threat data and assumptions will be provided to DIA for review. (Task 1.5)

Any systematic investigation of urban C4ISR requires credible data (see tasks 1.4, 1.5, and 1.6). For example, how will the JTF operate (i.e. doctrine and CONOPS) ? How will the threat oppose JTF actions (i.e. order of battle, disposition, and movement) ? What are the critical conditions of the urban battlespace ? There is currently little or no validated data for any of the above. The study will proceed with the best available data, likely an extrapolation from non-urban sources. The sub panel will evaluate these unavoidable data extrapolations and assumptions to ensure that the study remains credible.

2.2 Objective 2: Define the important objectives and decisions (Blue and Red) for selected urban operations.

Task 2.1 Identify Blue courses of action for selected urban objectives and operations.

Task 2.2 Identify Red courses of action for selected urban objectives and operations

The EEI Sub panel will identify and prioritize selected urban objectives and operations. The sub panel will identify courses of action and key decision points associated with Blue urban operations. Selected courses of action and decision points will be used to prioritize information needs (EEIs and IERs).

2.3 Objective 3. Identify Essential Elements of Information (EEIs) and Information Exchange Requirements (IERs) to support selected elements of urban operations.

Task 3.1 Determine and prioritize essential elements of information (EEIs) required to support friendly objectives, operations, and courses of action in baseline urban scenario and excursions.

Task 3.2 Identify detailed information needs (timeliness, accuracy, completeness, revisit rate, etc.) for selected high priority EEIs in different urban scenarios and during different scenario phases.

Task 3.3 Identify detailed information exchanges associated with high priority EEIs, objectives and operations in different urban scenarios and during different scenario phases.

Task 3.4 Review EEIs with CINC J2 representatives.

Task 3.5 Review IERs with CINC J3 representatives

Task 3.6 Validate EEIs and IERs in seminar/wargame.

The EEI Sub panel will identify and prioritize the essential elements of information to supported selected urban objectives and courses of action. Operational architecture and influence diagrams may be used to illustrate the information needs and exchange requirements for selected friendly force elements at different phases of the baseline scenario.

The Marine Corps Intelligence Activity draft “*Urban Generic Intelligence Requirements Handbook*” will be a primary source of urban EEI’s. This sub panel will develop draft, prioritized EEIs for study scenarios. The LLW JWCA and this study will sponsor a seminar/wargame to validate the prioritized EEIs and IERS (*Tasks 3.6*)

The sub panel will address the quality of information (e.g. accuracy, timeliness, update rate) needed for selected, high priority EEI’s. Greater detail may be needed for C4ISR performance analysis. (*Tasks 3.2 and 3.3*)

The sub panel will request CINC input and review regarding EEIs and operational architectures. Data will be updated based on timely CINC responses. (*Tasks 3.4 and 3.5*)

2.4 Objective 4: Describe the cause-and-effect relationships between selected objectives in urban operations and C4ISR, Precision Strike, and Dominant Maneuver capabilities and force levels.

- Task 4.1 Identify measures of performance and effectiveness (MOPs and MOEs) to assess (qualitatively and quantitatively) the ability of C4ISR, Precision Strike, and Dominant Maneuver performance on effectiveness for selected urban objectives and operations.
- Task 4.2 Describe the influence of selected, high priority MOPs on measures of effectiveness and outcome for selected urban objectives and operations
- Task 4.3 Conduct research to identify information regarding C4ISR, Precision Engagement, and Dominant Maneuver performance in complex and urban terrain.
- Task 4.4 Evaluate and select models and simulations to assess C4ISR, strike, and maneuver performance in urban terrain.
- Task 4.5 Evaluate and select models and simulations to assess the impact of C4ISR, strike, and maneuver performance on the outcomes of selected urban operations.

The System Performance Sub panels will address this objective.

The sub panel will identify measures of performance (MOPs) that describe the extent to which high priority, urban EEIs and IERS are met and that characterize the impact of C4ISR on battle outcome. Framing discussions in terms of MOPs will add precision to seminar/wargame validation of requirements and shortfalls. Selected MOPs will be used to focus development of options for future, quantitative ISR performance analysis. The sub panel will evaluate the suitability of the hierarchy of MOPs used in the *DSC Multi-INT Fusion Study* to urban scenarios. (Task 4.1)

The sub panel will describe the impact of selected, high priority EEI's (and associated MOPs) on battle outcome and/or the ability to meet JTF operational objectives. Explicit discussion and understanding of the assumed links between C4ISR performance and combat outcome will add precision to the seminar/wargame prioritization of ISR requirements and shortfalls. (Task 4.2)

The sub panel will compile information regarding C4ISR, strike, and maneuver performance degradation in complex, and if available, urban terrain. All potential sources of information (actual, exercise, experimental, analysis, expert elicitation) should be consulted. This data will be used in the seminar/wargame to identify the state of knowledge regarding C4ISR, strike, and maneuver performance under urban or urban-like conditions. (Task 4.3)

The sub panel will evaluate the capability of the Discrete Event Simulator toolset (and associated databases) and NETWARS to estimate C4ISR performance in urban terrain. At a minimum, an option will be developed to modify and validate NETWARS, the ISR Mission Planner, AIM, ASAP, SIGINT, and MASINT models and databases for use with urban terrain. Options will include rough order of magnitude estimates of cost and schedule. (Task 4.4)

The Effectiveness sub panel will evaluate whether JCATS (and associated databases) can be used in federation with one or more high fidelity ISR and communications models to assess the impact of ISR on battle outcome. This option will include a rough order of magnitude estimate of cost and schedule. (*Task 4.5*)

2.5 Objective 5: Describe current and programmed C4ISR, Precision Strike, and Dominant Maneuver force structure, systems and architectures available for selected urban operations.

Task 5.1 Compile current and programmed C4ISR, Precision Engagement, and Dominant Maneuver system acquisition and fielding plans for friendly force elements in baseline scenario and excursions.

Task 5.2 Describe current and planned architectures in baseline scenario and excursions.

Task 5.3 Provide technical descriptions of current and planned systems sufficient to estimate performance under baseline scenario conditions and excursions.

Task 5.4 Identify systems used in past operations on urban terrain.

The Architectures and Alternatives Sub panel will identify and describe the current and programmed force structure and systems. Current and programmed C4ISR capabilities will be based on the current FYDP.

This sub panel will determine the C4ISR, Precision Engagement, and Dominant Maneuver systems available for urban operations. For example, these may include: National Technical Means, U-2, UAV, F-18 D/F, RC-135, EP-3E; GRCS, JSTARS, and HUMINT. This information will be used by the Performance Sub panel (see task ..) to identify potential shortfalls in urban scenarios. (*Task 5.1*)

The sub panel will develop technical descriptions of selected systems as needed for quantitative analysis of performance and effectiveness in urban environments. Much of this data may already be available from previous studies. (*Task 5.3*)

2.6 Objective 6: Estimate the impact of C4ISR, strike, and maneuver performance on effectiveness in selected urban operations.

Task 6.1 Research sources of C4ISR, Precision Engagement, and Dominant Maneuver performance data and compile urban performance database.

Task 6.2 Identify C4ISR, strike, and maneuver shortfalls and lessons learned from past operations on urban terrain.

Task 6.3 Develop Run Plans for use of Discrete Event Simulator suite, NETWARS, and JCATS or equivalent methods to evaluate impact of performance on effectiveness in selected urban operations.

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Task 6.4 Assess capability of current/programmed C4ISR, strike, and maneuver systems and architectures to satisfy requirements for selected urban operations under a range of potential conditions.

Task 6.5 Identify and prioritize unsatisfied C4ISR requirements for selected urban operations under a range of conditions.

The Effectiveness Sub panel will evaluate the impact of information and weapon system and maneuver performance on effectiveness in selected urban operations.

The study will use one or more seminar/wargames to assess the ability of current and programmed C4ISR, Precision Strike, and Dominant Maneuver systems to address requirements for selected urban operations identified in the first seminar. For each prioritized list of EEIs and IERS, the members of the sub panel will conduct a preliminary survey of whether the current capability to satisfy each is "high", "moderate", or "low" with supporting rationale. This survey will provide read-ahead material and focus research to prepare for the wargame/seminar to identify shortfalls. (*Task 6.4*)

As validated urban data and models emerge during the study, greater emphasis will be placed on qualitative methods. (*Task 6.4*)

Based on the preliminary results of the LLW JWCA MOUT Seminar/Wargame, types of urban ISR shortfalls (reduce number ISR shortfalls and add selected C2, strike, and maneuver shortfalls) may include (*Task 6.5*):

1. Lack of an intelligence architecture that provides 24 hour reach-back and limited direct access to a centralized urban database (emphasis on urban characteristics).
2. Lack of urban infrastructure database capable of rapid updates.
3. Lack of system to provide management and fusion of various intelligence databases.
4. Lack of urban IPB decision support system.
5. Inability to conduct rapid Demographic Survey and update database.
6. Inability to conduct rapid Multi-spectral Environmental Survey and database.
7. Improve limited capability to meet increased urban ITT requirement.
8. Architecture does not support 2-way reachback to conduct Technical Support Functions.
9. Cannot provide precise geo-location to establish battlespace awareness (+/- 1 m tactical, +/- 10 m operational).
10. Limited 3D mapping and display capability.
11. Lack of wide area reconnaissance system with subterranean and interior capability.
12. Limited capability to determine enemy location.
13. Limited capability to distinguish refugees and civilians from soldiers.
14. Limited capability to identify critical urban nodes (e.g. power, water, electricity).
15. Limited capability to satisfy increased need for detailed close reconnaissance (targets includes air, surface, and subterranean).
16. Inability to detect and ID WMD/HAZMAT sites and effluence.
17. Inability for precise location of telephonic/radio traffic (+/- 10 m)
18. Lack of capability for continuous, multi-spectral intelligence collection to support urban IPB (e.g. LOC, enemy OOB/COA's/intent, non-combatants, critical points (terrain, infrastructure, cultural, hazardous materials).
19. Lack of standoff ability to see into buildings.
20. Improve limited capability to conduct BDA in built up areas.
21. Limited HUMINT capabilities.

2.7 Objective 7: Identify potential tradeoffs between Precision Strike and Dominant Maneuver force levels and C4ISR information for selected urban objectives and operations.

Task 7.1 Identify equal effectiveness value of information (and C4ISR performance) in terms of strike and maneuver force levels for selected cases.

Task 7.2 Identify potential changes in threat courses of action in reaction to reduction in force levels.

The Effectiveness Sub panel will use the results of previous tasks to determine the approximate equivalent strike and maneuver force levels for selected cases.

2.8 Objective 8: Identify limitations of this analysis and lessons learned to improve subsequent assessments.

All sub panels will document the limitations of this analysis and identify lessons learned that may improve subsequent assessments of this type.

2.9 Objective 9: Synthesize a final product for use by the Urban Working Group. Complete the final briefing by ??????????. Complete draft final report by ??????????.

The Study Working Group will provide an in-progress review (IPR) briefing following the completion of objectives one through four and additional IPR briefings as deemed necessary by the Study Director. The study group will develop a final report that describes recommendations, methodology, and supporting data. The final report will include an unclassified executive summary and will be published in written and CD formats. The working group will maintain study web sites on the Internet and SIPRNET as a means of communicating study progress with the CINCs.

3 ANALYSIS APPROACH

3.1 Architecture Descriptions

Current and programmed ISR system and technical architectures will be based on the *J2 Recce 2010 Study*. C3 architectures will be based on the *Global Information Grid* study. Strike and maneuver architectures will be provided by Service representatives.

3.2 Scenarios

The baseline scenario will be refined from the J8 MOUT Seminar/Wargame "*Offensive Operations to Regain Control of City*" module. Other scenarios will include seminar/wargame modules: (2) Noncombatant Evacuation; (3) Humanitarian Assistance/Disaster Relief; (4) Defense Operations to Retain Control of City; (5) Consequence Management/Direct Actions to Minimize Impact of WMD; (6) Transition.

In addition, operational situations and vignettes that occur in the context of the larger scenario may be constructed to model urban performance of baseline and alternative ISR systems to perform IPB, maintain SA, support force protection, and provide targeting against key battlespace objects. Guided by the J8 MOUT Seminar/Wargame, vignettes may investigate detection of: (1) critical nodes/points (power, water, electricity, cultural sites, terrain); (2) status of services and transportation/lines-of-communication; (3) refugee concentrations; (4) HAZMAT sites; (5) troop concentrations; (6) enemy order-of-battle/available courses-of-action/intent; (7) WMD sites; (8) C2 facilities; (9) armor; (10) artillery; (11) SAM's; (12) SSM's; (13) snipers; (14) RPG/MANPAD launchers; (15) weapons caches; and (16) effluence.

3.3 Measures of Performance and Effectiveness

3.3.1 Measures of Performance

The Measures of Performance (MOPs) will be developed within the working group established to accomplish this effort. MOPs will likely include: (1) percent of battlefield objects (e.g. Red Order of Battle, non-combatants, urban terrain features) detected; (2) percent of targets identified; (3) percent of targets tracked; (4) percent of targets at risk of attack; and (5) other measures of the quantity, quality, timeliness, and availability of information provided to the warfighter. MOPs for lower levels of conflict (e.g. Peace Operations) may also include measures of the non-intrusiveness of the information collection process. All MOP's are imagined to be probability statements as a function of time frame (present or future), region of the urban or adjacent battlefield, phase of battle, target type, etc.

3.3.2 Measures of Effectiveness

The Measures of Effectiveness (MOEs) will be developed within the working group established to accomplish this effort. MOEs will likely include loss exchange ratios, friendly and non-combatant losses, fratricide statistics, achievement of objectives, and time to achieve objectives.

Friendly JMOUT operational objectives may include: (1) control urban centers of gravity, population, and/or area; (2) capture, isolate, and/or disable enemy forces; (3) capture enemy weapons; (4) reduce enemy fires or incidents of violence; (5) rescue friendly personnel; and (6) provide food and shelter.

Constraints or costs related to friendly actions to achieve these objectives may include: (1) friendly losses; (2) non-combatant losses; (3) collateral damage; (4) damage to infrastructure needed for follow-on friendly actions; and (5) enemy losses.

3.4 Conferences and Seminar/Wargames

The study group, in cooperation with the DM JWCA Urban Working Group will sponsor up to three conferences and seminar/wargames to: (1) prioritize/refine/validate urban EEIs and IERs to support selected urban objectives and courses of action; and (2) validate assessments of capability of current and planned C4ISR, strike, and maneuver capabilities to satisfy objectives. Ensuring the right mix of experience, preparation (e.g. walk-through by facilitators, tentative drafts, read-ahead material), and a systematic, consensus-building approach are critical.

3.5 Analysis Support for Seminar/Wargames

In order to develop consensus regarding general C4ISR, strike, and maneuver requirements, capabilities, and shortfalls, seminar/wargame participants will need to understand the range of potential characteristics of urban scenarios and the best available data regarding performance in such environments.

This study will use existing databases to compare the distinguishing features of a representative list of potential locations for the six study modules (Offensive Operations to Regain Control of City; Noncombatant Evacuation; etc.) Major differences between driving characteristics (i.e. major influence on requirement or shortfall) of the baseline (Seoul, South Korea) and other potentially important cities will prompt seminar/wargame excursions.

Research for a related urban C4 study¹ has shown that many urban “lessons-learned” are anecdotal and sometimes ignored in conflict. The study will explore all potential sources of performance data in complex environments to provide a common reference for scenario/wargame participants.

¹ Sensor-to-Shooter (Military Operations on Urban Terrain), J6/DSC

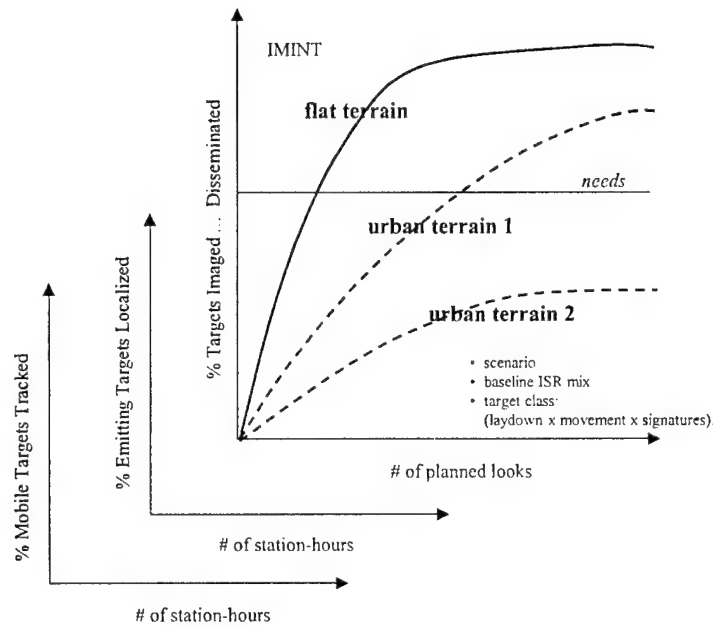
3.6 Modeling and Simulation

ISR systems develop and disseminate information to achieve Dominant Battlespace Awareness (DBA). The elements of DBA include information needed for Situational Awareness (for campaign and operations planning, force allocation, assignment and disposition), Force Protection, and Targeting of fixed and mobile objects.

Selected information states include: unknown; undetected; detected but condition unknown; damaged/dead but presumed alive; alive but presumed dead; targeted; dead. Important fixed urban targets may include: critical infrastructure (e.g. power, water, electricity nodes, cultural sites, HAZMAT sites, WMD sites, buildings), POL, weapon caches, potential hide sites, and C2 facilities. Important mobile urban targets may include: refugee concentrations; troop concentrations; artillery; armor; SAM's; SSM's; C2 nodes; WMD; snipers; RPG launchers.

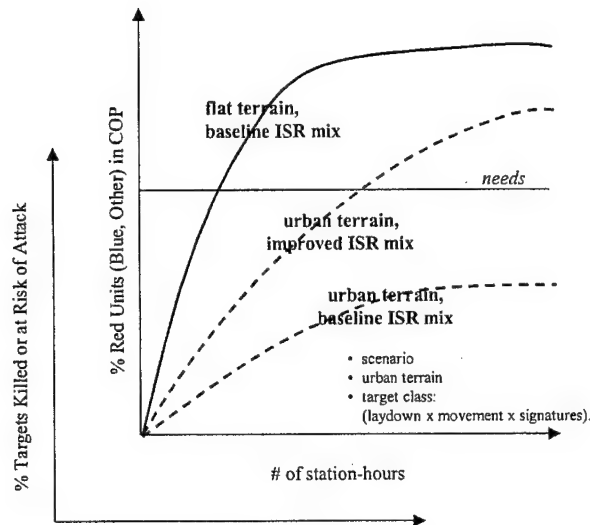
In order to reduce the large number of objects to tractable dimensions, targets must often be assigned to classes that reflect similar characteristics (e.g.. the "activity x signature x movement" classification scheme used in DSC FY-97 Task 2, *"Impact of C4ISR on Strike Warfare"*).

The study will assess the capability of the Discrete Event Simulator (and associated databases) to evaluate urban MOP's. An example figure (form of results) illustrates the notional impact of two types of urban terrain on baseline IMINT, SIGINT, and MASINT performance in a given scenario against a given class of targets. In this example, greater level of effort (e.g. hours on station) cannot restore baseline ISR performance in the more difficult urban terrain.



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Continuing with the notional example, an improved mix of systems (e.g. addition of urban UAV and UGV with tailored sensor packages) allows ISR “needs” to be met with additional effort.



The sub panel will assess the capability of the Joint Conflict and Tactical Simulation (associated databases and loosely federated high-fidelity models, if any) to evaluate the impact of ISR performance on urban MOE's.

3.7 Analysis Cases

The table below highlights important elements of the cases that will be considered in the seminar/wargames and supporting historical and performance analysis. Note that the columns (excluding the base case) do not represent specific analysis cases. Rather, each row represents the range that will be considered in some form during the study. We anticipate that the table below will evolve during the course of the study.

Table 3. Key Elements of Analysis Cases

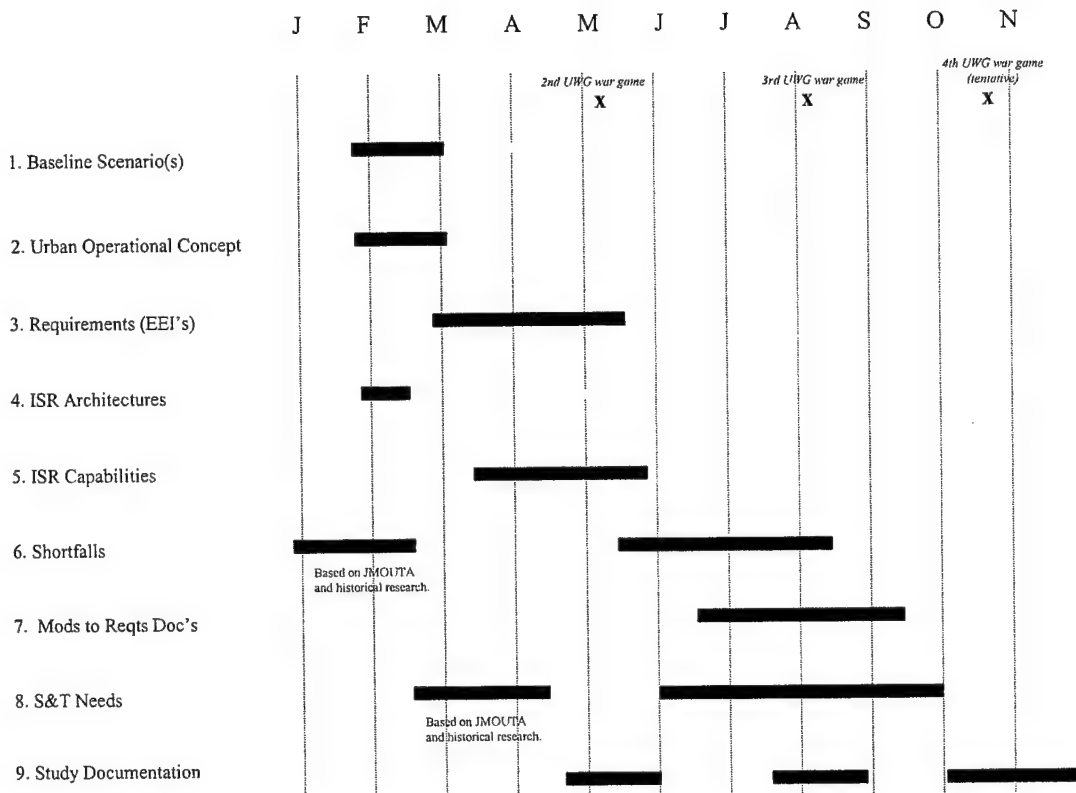
	Base Case	Variation 1	Variation 2	Others
Time Frame	end of current FYDP			
ISR Architecture	current POM	current POM +selected MNS	current POM +selected MNS +modifications	
Level of Conflict	MTW	Stability ops prior to escalation to MTW		
City	Seoul	Will be considered for 4 th UWG wargame		
Scenario module	offensive ops	HA/DR + suspected WMD release		
Terrain Excursions	actual	lat/long variations	synthetic terrain variations	
Threat Defense	static	mobile		
Threat Disposition and Maneuver	optimized for urban	derived from non-urban		

4 PLAN OF ACTION AND MILESTONES

4.1 Schedule

The JWCA cycle dictates that this study should be completed prior to December 1999. The DSC Senior Steering Group has directed that this study should be substantially completed during FY99 (objective 8). As such, the analysis will be scheduled to deliver a final briefing to the Urban Working Group by _____.

The chart highlights the current study schedule which will be updated bi-weekly over the course of the study.



4.2 Deliverables

The following deliverables will be available to the Urban Working Group and ISR JWCA as indicated in the table below.

Table 4. Schedule of Deliverables

Task	Deliverable	Date Due
0a	Terms of Reference	12 Jan 00
0b	Study Plan	12 Jan
0c	Schedule (updated bi-weekly)	n/a
0d	List of References and Sources (updated bi-weekly)	n/a
1a	Baseline scenario description (approved by UWG for study use).	9 Feb
1b	Joint urban operational concept (approved by UWG for study use).	2 Mar
1c	Identification of EEI's and ISR shortfalls from selected urban operations. (proposed/revised after CINC review)	4 May
1d	Comparison of baseline scenario with potential range of urban conditions.	4 May
2	Prioritized urban EEI's (proposed / revised after CINC review / validated in wargame).	16 Mar 4 May 18 May
3	Current and programmed ISR architecture in baseline urban scenario.	12 Feb
4a	Survey of ISR performance, shortfalls, and lessons learned in urban environments (based on performance data and subject matter expert elicitation).	7 May
4b	Assessment of capability of programmed systems to satisfy urban ISR requirements in baseline scenario (proposed / revised after CINC review and validation in wargame)	8 Jun / 11 Aug
5,6	Assessment of potential of emerging ISR capabilities (from CRD, MNS, ORD) to satisfy high priority urban ISR needs.	11 Aug
7	Assessment of potential of ISR science and technology areas to yield solutions to high priority urban ISR needs. (proposed / validated)	24 Sept / 27 Oct
8a	Draft documentation of up to three seminar/wargames. Final documentation will be included in study report.	1 week after game
8b	Final study briefing to UWG. Interim briefings as required.	10 Nov
8c	Final study report (will document study findings and methodology and include at least two drafts in addition to the final version) (first draft / final)	24 Nov / 11 Jan

DEFINITION OF TERMS

Concept of Operations -- (DOD) A verbal or graphic statement, in broad outline, of a commander's assumptions or intent in regard to an operation or series of operations. The concept of operations frequently is embodied in campaign plans and operation plans; in the latter case, particularly when the plans cover a series of connected operations to be carried out simultaneously or in succession. The concept is designed to give an overall picture of the operation. It is included primarily for additional clarity of purpose. Also called commander's concept. (Joint Pub 1-02)

Contain -- (DOD, NATO) To stop, hold, or surround the forces of the enemy or to cause the enemy to center activity on a given front and to prevent his withdrawing any part of his forces for use elsewhere. (Joint Pub 1-02)

Correlation -- The process that associates and combines data on a single entity or subject from independent observations, in order to improve the reliability or credibility of the information. (Joint Pub 1-02)

Denial Measure -- (DOD, NATO) An action to hinder or deny the enemy the use of space, personnel, or facilities. It may include destruction, removal, contamination, or erection of obstructions. (Joint Pub 1-02)

Essential Elements of Information -- (DOD) The critical items of information regarding the enemy and the environment needed by the commander by a particular time to relate with other available information and intelligence in order to assist in reaching a logical decision. Also called EEL. (Joint Pub 1-02)

Exploitation -- (DOD, NATO) 1. Taking full advantage of success in battle and following up initial gains. 2. Taking full advantage of any information that has come to hand for tactical, operational, or strategic purposes. 3. An offensive operation that usually follows a successful attack and is designed to disorganize the enemy in depth. (Joint Pub 1-02)

Fusion - (DOD) In intelligence usage, the process of examining all sources of intelligence and information to derive a complete assessment of activity. (Joint Pub 1-02)

Fusion -- The integration of data or information from multiple sources to produce specific comprehensive unified data about an entity; frequently, an operation on two or more data sets to produce a result that is not evident in the supporting data sets and in which the supporting data sets may not be identifiable from the result alone. (MTI and IMINT Fusion Study Terms of Reference)

HUMINT (human intelligence) - (DOD, NATO) A category of intelligence derived from information collected and provided by human sources. (Joint Pub 1-02)

IMINT (imagery intelligence) – Intelligence derived from the exploitation of collection by visual photography, infrared sensors, lasers, electro-optics, and radar sensors such as synthetic aperture radar wherein images of objects are reproduced optically or electronically on film, electronic display devices or other media. (Joint Pub 1-02))

Intelligence - (DOD) 1. The product resulting from the collection, processing, integration, analysis, evaluation, and interpretation of available information concerning foreign countries or areas. 2. Information and knowledge about an adversary obtained through observation, investigation, analysis, or understanding. See also acoustic intelligence; all-source intelligence; basic intelligence; civil defense intelligence; combat intelligence; communications intelligence; critical intelligence; current intelligence; departmental intelligence; domestic intelligence; electronics intelligence; electro-optical intelligence; escape and evasion intelligence; foreign intelligence; foreign instrumentation signals intelligence; general military intelligence; human resources intelligence; imagery intelligence; joint intelligence; laser intelligence; measurement and signature intelligence; medical intelligence; merchant intelligence; military intelligence; national intelligence; nuclear intelligence; open source intelligence; operational intelligence; photographic intelligence; political intelligence; radar intelligence; radiation intelligence; scientific and technical intelligence; security intelligence; strategic intelligence; tactical intelligence; target intelligence; technical intelligence; technical operational intelligence; telemetry intelligence; terrain intelligence; unintentional radiation intelligence. (Joint Pub 1-02)

Isolate – A tactical task given to a unit to seal off (both physically and psychologically) an enemy from his sources of support, to deny an enemy freedom of movement, and prevent an enemy unit from having contact with other enemy forces. An enemy must not be allowed sanctuary within his present position. (See also encirclement). See FMs 7-7, 7-8, 17-956, and 71-123. (FM 101-5-1/MCRP 5-2A)

MASINT (measurement and signature intelligence) - (DOD) Scientific and technical intelligence obtained by quantitative and qualitative analysis of data (metric, angle, spatial, wavelength, time dependence, modulation, plasma, and hydro magnetic) derived from specific technical sensors for the purpose of identifying any distinctive features associated with the target. The detected feature may be either reflected or emitted. (Joint Pub 1-02)

Mission Area Analysis -- A process by which warfighter deficiencies are determined, technological opportunities for increased system effectiveness and/or cost reduction are assessed and mission needs are identified. (CJCSI 3170.01)

Mission Need -- A deficiency in current capabilities or an opportunity to provide new capabilities (or enhance existing capabilities) through the use of new technologies. The are expressed in broad operational terms by the DOD components. (CJCSI 3170.01)

Military Operations on Urbanized Terrain (MOUT) -- All military actions that are planned and conducted on a topographical complex and its adjacent natural terrain where manmade construction is the dominant feature. It includes combat in cities, which is that portion of MOUT

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involving house-to-house and street-to-street fighting in towns and cities. (See FMs 90-10 and 90-10-1. (FM 101-5-1/MCRP 5-2A)

Military Requirement -- An established need justifying the timely allocation of resources to achieve a capability to accomplish approved objectives, missions, or tasks. (Joint Pub 1-02)

MTI (moving target indicator) - (DOD, NATO) A radar presentation that shows only targets that are in motion. Signals from stationary targets are subtracted out of the return signal by the output of a suitable memory circuit. (Joint Pub 1-02)

MTI -- A radar capability that operates against moving targets by processing the Doppler phase shift of returning energy. (MTI/IMINT Fusion Study Terms of Reference)

Noncombatant Evacuation Operations -- (DOD) Operations directed by the Department of State, the Department of Defense, or other appropriate authority whereby noncombatants are evacuated from foreign countries when their lives are endangered by war, civil unrest, or natural disaster to safe havens or to the United States. Also called NEO. See also evacuation; NEOPACK; noncombatant evacuees; safe haven. (Joint Pub 1-02)

Operational Task -- Those discrete events or actions that force elements are to accomplish in order to achieve an operational objective. (RAND, *Strategies to Tasks, A Framework for Linking Means and Ends*)

Peace Operations -- (DOD) A broad term that encompasses peacekeeping operations and peace enforcement operations conducted in support of diplomatic efforts to establish and maintain peace. See also peace building; peace enforcement; peacekeeping; and peacemaking. (Joint Pub 1-02)

Penetration -- (DOD, NATO) In land operations, a form of offensive that seeks to break through the enemy's defense and disrupt the defensive system. (Joint Pub 1-02)

Reconnaissance - (DOD, NATO) A mission undertaken to obtain, by visual observation or other detection methods, information about the activities and resources of an enemy or potential enemy, or to secure data concerning the meteorological, hydrographic, or geographic characteristics of a particular area. (Joint Pub 1-02)

Requirement -- The need of an operational user, initially expressed in broad operational capability in the format of a Mission Need Statement. It progressively evolves to system-specific performance requirements in the Operational Requirements Document. (CJCSI 3170.01)

SIGINT (signals intelligence) - (DOD) 1. A category of intelligence comprising either individually or in combination all communications intelligence, electronics intelligence, and foreign instrumentation signals intelligence, however transmitted. 2. Intelligence derived from communications, electronics, and foreign instrumentation signals. Also called SIGINT. See also

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communications intelligence; electronics intelligence; foreign instrumentation signals intelligence. (Joint Pub 1-02)

Surveillance - (DOD, NATO) The systematic observation of aerospace, surface or subsurface areas, places, persons, or things, by visual, aural, electronic, photographic, or other means. See also air surveillance; satellite and missile surveillance; sea surveillance. (Joint Pub 1-02)

Task -- A discrete event or action, not specific to a single unit, weapon system, or individual that enables a mission or function to be performed. (CJCSM 3500.4A)

Tasking, Processing, Exploitation and Dissemination (TPED) – Tasking: planning and directing the activities within the end-to-end cycle. Processing: converting the raw data in a usable format. Exploitation: the extraction of information from a source. Dissemination: the movement and storage of data and information. (MTI/IMINT Fusion Study Terms of Reference).

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Appendix C-6
Advancing C4ISR Assessment Workshop
Notional Study Plan
Counter-Weapons of Mass Destruction/Terrorism
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(Note: This notional study plan is a product of the Counter-Weapons of Mass Destruction/Terrorism Working Group in the above workshop. It represents the member's suggestions only — it is NOT an actual government study plan.)

1. Introduction

1.1. Background

The new administration has tasked the National Security Council to sponsor a study evaluating the United States' C4ISR ability to support mission effectiveness for Counter-Terrorism/Weapons of Mass Destruction (CT/WMD) in the areas of deterrence, mitigation, response, and remediation/reconstitution. The study should account for the fact that more than 31 different agencies are involved in this process, and that depending on whether it is a domestic or foreign crisis, there are different lead agencies involved. The overall output of this study will help frame the issues leading into the next QDR and help the administration make force structure tradeoffs and acquisition decisions.

1.2. Assumptions

The assumptions of the study are:

- 1) Current C4ISR force structure, capabilities and architecture will be addressed.
- 2) Only US capabilities of response will be involved, no foreign assistance will be addressed.
- 3) Once event has occurred the study will address tactical level issues of response and remediation.

1.3. Scope

The scope of the study will examine Federal, Department of Defense, and Intelligence Community to develop analytic approaches to understand C4ISR effectiveness to detect, mitigate, respond, and remediate/reconstitute pre-trans-post CT/WMD events in both foreign and domestic response situations.

1.4. Terms and Definitions

- 1.4.1. **Terrorism** - (DOD) The calculated use of unlawful violence or threat of unlawful violence to inculcate fear; intended to coerce or to intimidate governments or societies in the pursuit of goals that are generally political, religious, or ideological. [JP 1-02]
- 1.4.2. **Terrorist Incident** - The FBI defines a terrorist incident as a violent act, or an act dangerous to human life, in violation of the criminal laws of the United States or of any State, to intimidate or coerce a government, the civilian population, or any segment thereof in furtherance of political or social objectives.

- 1.4.3. **Counterterrorism** - (DOD) Offensive measures taken to prevent, deter, and respond to terrorism. Also called CT. [JP 1-02]
- 1.4.4. **Crisis Management** - The FBI defines crisis management as measures to identify, acquire, and plan the use of resources needed to anticipate, prevent, and/or resolve a threat or act of terrorism.
- 1.4.5. **Consequence Management** - FEMA defines consequence management as measures to protect public health and safety, restore essential government services, and provide emergency relief to governments, businesses, and individuals affected by the consequences of terrorism.
- 1.4.6. **Weapons of Mass Destruction**

- Title 18, U.S.C. 2332a: (1) any destructive device as defined in section 921 of this title, [which reads] any explosive, incendiary, or poison gas, bomb, grenade, rocket having a propellant charge of more than four ounces, missile having an explosive or incendiary charge of more than one-quarter ounce, mine or device similar to the above; (2) poison gas; (3) any weapon involving a disease organism; or (4) any weapon that is designed to release radiation or radioactivity at a level dangerous to human life. [Title 18, USC 2332a]
- DOD: In arms control usage, weapons that are capable of a high order of destruction and/or of being used in such a manner as to destroy large numbers of people. Can be nuclear, chemical, biological, and radiological weapons, but excludes the means of transporting or propelling the weapon where such means is a separable and divisible part of the weapon. Also called WMD. [JP 1-02]

Six categories of WMD include chemical, biological, nuclear, radiological, conventional high explosives, and industrial chemicals (toxins).

- 1.4.7. **Detection** – In nuclear, biological, and chemical (NBC) environments, the act of locating NBC hazards by use of NBC detectors or monitoring and/or survey teams. [JP 1-02]
- 1.4.8. **Mitigation** - Those activities designed to alleviate the effects of a major disaster or emergency or long-term activities to minimize the potentially adverse effects of future disaster in affected areas. [FEMA Terms and Definitions]
- 1.4.9. **Military Support to Civil Authorities (MSCA)** – Those activities and measures taken by the DoD Components to foster mutual assistance and support between the Department of Defense and any civil government agency in planning or preparedness for, or in the application of resources for response to, the consequences of civil emergencies or attacks, including national security emergencies. [DODD 3025.1]
- 1.4.10. **Response** – Activities to address the immediate and short-term effects of an emergency or disaster. Response includes immediate actions to save lives, protect property, and meet basic human needs. [FEMA Terms and Definitions]
- 1.4.11. **Recovery**
 - DoD: Those long-term activities and programs beyond the initial crisis period of an emergency or disaster designed to return all systems to normal status or to reconstitute these systems to a new condition that is less vulnerable. DoD is not usually involved in MSCA recovery activities. [DODD 3025.1]
 - FEMA: Activities traditionally associated with providing Federal supplemental disaster relief assistance under a Presidential major disaster declaration. These activities usually begin within days after the event and continue after response

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activity ceases. Recovery includes individual and public assistance programs that provide temporary housing assistance, as well as grants and loans to eligible individuals and government entities to recover from the effects of a disaster.

- 1.4.12. **Contingency Plan** - (DOD) A plan for major contingencies that can reasonably be anticipated in the principal geographic subareas of the command. [JP 1-02]
- 1.4.13. **Indications and Warning** - (DOD) Those intelligence activities intended to detect and report time-sensitive intelligence information on foreign developments that could involve a threat to the United States or allied/coalition military, political, or economic interests or to US citizens abroad. It includes forewarning of enemy actions or intentions; the imminence of hostilities; insurgency; nuclear/non-nuclear attack on the United States, its overseas forces, or allied/coalition nations; hostile reactions to US reconnaissance activities; terrorists' attacks; and other similar events. Also called I&W. [JP 1-02]
- 1.4.14. **Battle Damage Assessment** - (DOD) The timely and accurate estimate of damage resulting from the application of military force, either lethal or non-lethal, against a predetermined objective. Battle damage assessment can be applied to the employment of all types of weapon systems (air, ground, naval, and special forces weapon systems) throughout the range of military operations. Battle damage assessment is primarily an intelligence responsibility with required inputs and coordination from the operators. Battle damage assessment is composed of physical damage assessment, functional damage assessment, and target system assessment. Also called BDA. [JP 1-02]

2. Objectives

Based on the issues identified by the National Security Council, the following objectives will be used to guide development of the study plan:

- Determine how C4ISR is applied to threat detection and warning.
- Determine how information can be used to support contingency planning and how C4ISR can provide you that information.
- Determine the impact of C4ISR on first response and inter-government crisis C2.
- Determine the impact of C4ISR or long-term recovery efforts.

3. Study Organization

3.1. Oversight

The CT/WMD study will be accomplished in a collaborative fashion within a study group chaired by the National Security Council. The study's organization and oversight will be comprised of representatives, analysts, and contractors from organizations depicted in the following figure.

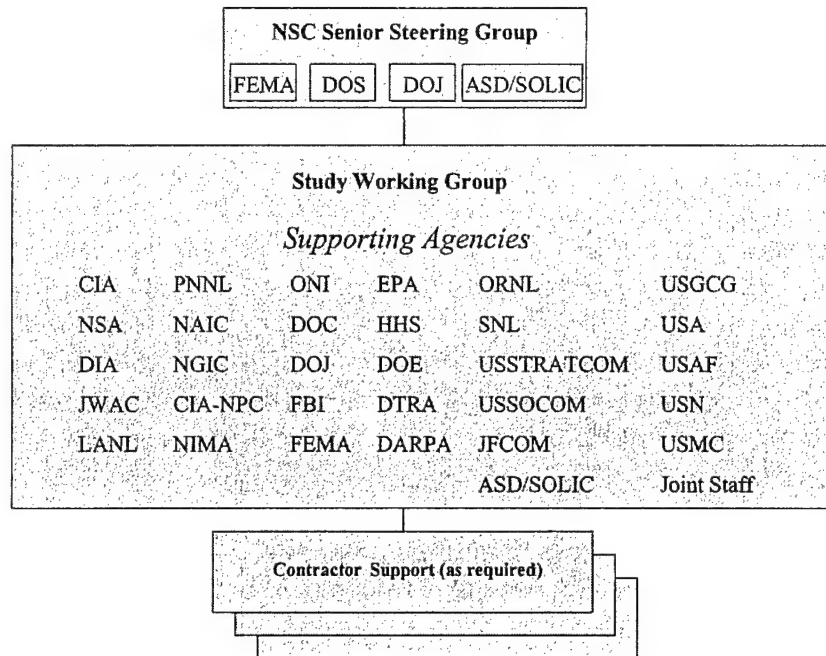


Figure 1: Study Organization

3.2. Organization of study working groups

To assist the oversight group in meeting the objectives and improving the analysis approach, the study working group will be composed of several sub-panels. Each sub-panel will be assigned specific roles and responsibilities.

- Deterrence sub-panel – This sub-panel will be responsible for addressing the first study objective. It will focus on how C4ISR can provide threat detection and warning and provide an assessment of how well current organization and capabilities meet this potential.
- Mitigation sub-panel - This sub-panel will be responsible for addressing the second study objective by concentrating on information support to contingency planning and vulnerability assessments
- Response sub-panel - This sub-panel will be responsible for addressing the third study objective. It will focus on determining the impact of C4ISR on first response and inter-government crisis C2 by assessing information requirements during the response phase and the ability of current C2 capabilities and architecture to satisfy those information, communication and C2 needs.
- Remediation/Reconstitution sub-panel - This sub-panel will be responsible for addressing the fourth study objective. It will focus on determining the impact of C4ISR on long term recovery efforts by assessing information requirements during this phase and the ability of current C2 capabilities and architecture to satisfy those information, communication and C2 needs.

Participants/Roles and Responsibilities

Each government agency in the study will assign participants to the various subpanels as depicted in the following table.

Participants	Deterrence	Mitigation	Response	Recovery
ASD/SOLIC				
CIA				
CIA-NPC				
DARPA				
DIA				
DOC				
DOE				
DOJ				
DTRA				
EPA				
FBI				
FEMA				
HHS				
JWAC				
LANL				
NAIC				
NGIC				
NIMA				
NSA				
ONI				
ORNL				
PNNL				
SNL				
USA				
USAF				
USGCG				
USMC				
USN				
USSOCOM				
USSTRATCOM				

Figure 2: Subpanels and Participants

4. Analysis Approach

In order to fully analyze how C4ISR can better support mission effectiveness of CT/WMD, it is important to understand the process by which a CT/WMD event unfolds. Figure 3 is used to outline the discussion and focus the analytic approaches of the study objectives.

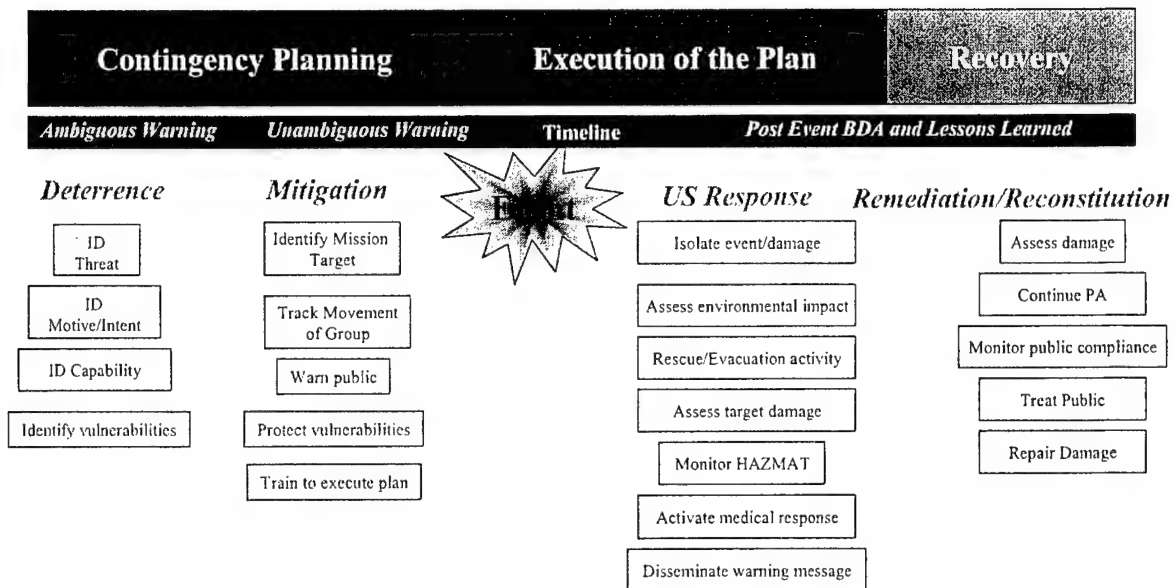


Figure 3: Process for CT/WMD Event

For each of the study objectives presented above, essential elements of analysis, methods, tools, and data sources are identified to provide a further breakdown of tasks involved.

4.1 Objective 1: Determine how C4ISR is applied to threat detection and warning.

Essential Elements of Analysis

1. What information is needed to identify the threat?
 - What is the nature of the threat organization/country?
 - Are there any relationships to 3rd parties?
 - What is the nature of their network?
 - What is the source and assessment of the group's finances?
 - What is the mission/intent of the group?
 - What capabilities (equipment, weapons, sources, WMD) of the group?
 - What is the group's training and modus operandi?
2. What current C4ISR capabilities provide that information?
3. What is the quantity, quality, and timeliness of information provided by C4ISR capabilities? Does it satisfy current requirements?

4.1.1 Methodology

The Deterrence sub-panel will begin to address the essential elements of analysis and their sub-questions by developing the influence diagrams to the ambiguous warning phase of the process (Figure 3),- meaning what data and information inputs influence the outcome or ability to understand that portion of the process. Then the sub-panel will identify which organizations can provide the data required to fully understand the process.

4.1.2 Scenarios

To fully analyze this objective, the study working group will select a scenario or a variety of scenarios for use by the sub-panel to facilitate analysis. Both foreign and domestic situations should be addressed, that include each chemical, biological, nuclear, radiological, conventional high explosives, and industrial chemical capability. Scenario data will be obtained from each of the contributing agencies e.g. DTRA, CINCs, and FEMA.

4.1.3 Tools/Wargames/Models/Live Exercises

A methodology using a qualitative process may be the best approach to assess this objective. The following table will be used to help outline the information requirements and organize the data for analysis.

Objective/Task	Information Requirements	Information Sources	Deficiencies	DTLOMS-F** Solutions	Comments
Obj #1	IR #1				
	IR #2				
	(etc)				
Obj #2	IR #1				
(etc)					

****Doctrine, Training, Leadership, Organization, Materiel, Soldier Requirements , and Facilities**

Detailed results from the analysis of the ambiguous warning phase of Fig.3 above will be used to define several objectives one would follow to as part of an C4ISR effort to provide I&W. Each objective will generate one or more information requirements. Each information requirement should generate a list of possible sources (C4ISR capabilities, organizations, etc.) that answer or contribute data to address the information requirement. Each source can be analyzed in terms of how well it satisfies the requirement and any deficiencies noted. Suggested remedies to any shortfalls can then be proposed.

4.1.4 Data Sources

The sub-panel will identify the best data source/information source to assess each task. Each task should map back to the overall process as described in Figure 3.

4.1.5 Measures

The sub-panel will identify the measures of effectiveness/performance to begin to identify where C4ISR investments can be made to improve mission performance in the areas of CT/WMD. The following table describes what MOPs/MOE's the sub-panel will use and how they will be measured.

Issue	MOE	MOE Description	How MOE will be evaluated
How well does current C4ISR provide the type of information needed?	(list one or more MOEs to address each issue)	(provide a definition of each MOE	(Describe the method to measure or calculate each MOE)
How well does current C4ISR provide the quality of information needed?			
How well does current C4ISR satisfy the timeliness of information needed?			

4.1.6 Schedule

The sub-panel will identify the schedule with milestones of how this portion of the study will be conducted and report back to the oversight group.

4.2 Objective 2: Determine how information can be used to support contingency planning.

Essential Elements of Analysis

1. What are the information requirements to develop a contingency plan? How can C4ISR provide you that information?
 - What is the mission of the group/threat?

- What weapons do they intend do use?
 - What location does the group intend to target/attack?
 - How is the group moving, transporting their personnel, equipment?
 - When is the attack going to take place?
2. What is the current C2 architecture that support the Contingency planning and execution?
 - Has Blue trained using this contingency plan?
 - How timely does the information need to be in order to execute the plan?
 - How distributed are Blue's forces going to be to respond/contain the event?
 3. What information is needed to understand Blue vulnerabilities?
 - How do you protect blue vulnerabilities?
 - What location does the group intend to target/attack?
 - What weapons do they intend do use?

4.2.1 Methodology

The Mitigation sub-panel will begin to address the essential elements of analysis and their sub-questions by developing the influence diagrams to the unambiguous warning phase of the process (Figure 3),- meaning what data and information inputs influence the outcome or ability to understand that portion of the process. Then the sub-panel will identify which organizations can provide the data required to fully understand the process.

4.2.2 Scenarios

To fully analyze this objective, the study working group will select a scenario or a variety of scenarios for use by the sub-panel to facilitate analysis. Both foreign and domestic situations should be addressed, that include each chemical, biological, nuclear, radiological, conventional high explosives, and industrial chemical capability. Scenario data will be obtained from each of the contributing agencies e.g. DTRA, CINCs, and FEMA.

4.2.3 Tools/Wargames/Models/Live Exercises

The best approach to analyzing this particular objective may be to conduct a no-notice planning/exercise. This is where the particular organizations and participating agencies are given a warning-order (notice that a threat is imminent; unambiguous warning) and are given 24-48 hours to develop the contingency plan. Within their planning, they must identify their information requirements—and specify number of locations that information must be disseminated to. This will begin to identify the information required to develop a comprehensive contingency plan and identify the architecture required to distribute that information so that the plan can be executed.

4.2.4 Data Sources

The sub-panel will identify the best data source/information source to assess each task in the area of contingency planning. Each task should map back to the overall process as described in Figure 3.

4.2.5 Measures

The sub-panel will identify the measures of effectiveness/performance to begin to identify where C4ISR investments can be made to improve mission performance in the areas of CT/WMD, specifically in the area of contingency planning. The following table describes what MOPs/MOE's the sub-panel will use and how they will be measured.

Issue	MOE	MOE Description	How MOE will be evaluated
How well does current C4ISR provide required information for Contingency planning and execution??	(list one or more MOEs to address each issue)	(provide a definition of each MOE)	(Describe the method to measure or calculate each MOE)
How well does current C2 architecture support Contingency planning and execution?			
How well do we understand Blue vulnerabilities?			

4.2.6 Schedule

Each sub-panel will identify the schedule with milestones of how this study will be conducted and report back to the oversight group.

4.3 Objective 3: Determine the impact of C4ISR on first response and inter-government crisis C2

Essential Elements of Analysis

1. What information is required for effective first response to an event?
 - Where did the attack take place?
 - What is the extent of the damage?
 - What is the environmental impact?
 - What type of weapon was used?
 - What are the ingress/egress routes for the rescue activity?
2. What is the current C2 architecture that supports first responders?
 - To what organizations do the first-responders need to reach back?
 - What information do the first responders need to contain the situation?

4.3.1 Methodology

The Response sub-panel will begin to address the essential elements of analysis and their sub-questions by developing the influence diagrams to the Post-event phase of the process (Figure 3),- meaning what data and information inputs influence the outcome or ability to understand that portion of the process. Then the sub-panel will identify which organizations can provide the data required to fully understand the process.

4.3.2 Scenarios

To fully analyze this objective, the study working group will select a scenario or a variety of scenarios for use by the sub-panel to facilitate analysis. Both foreign and domestic situations should be addressed, that include each chemical, biological, nuclear, radiological,

conventional high explosives, and industrial chemical capability. Scenario data will be obtained from each of the contributing agencies e.g. DTRA, CINCs, and FEMA.

4.3.3 Tools/Wargames/Models/Live Exercises

The best approach to analyzing this particular objective may be to use modeling and simulation techniques of the current C2 architectures. By assessing the C2 structure, one can identify how much information needs to be disseminated, thus determining how big the "pipes" need to be. In addition, M&S can be used to identify where single points of failure may be in the system and where alternative dissemination capabilities should or must be used. This analysis will begin to address where investments should be made to improve mission effectiveness of the first responders.

The sub-panel will employ the following models and simulations to conduct quantitative analysis of the C4ISR architecture:

Model/Simulation	Application
Model #1	(Describe how the model will be used in the study, i.e what issues will be addressed)
Master Timeline Curves (DTRA/SANDIA)	This model helps calculate area of dispersion of CBRN attack, rate of infection, probably number of casualties, etc. It will also help identify the decision window—where certain decisions can change the outcome of the event.
(etc)	

4.3.4 Data Sources

The sub-panel will identify the best data source/information source to assess each task in the area of first response. Each task should map back to the overall process as described in Figure 3.

4.3.5 Measures

The sub-panel will identify the measures of effectiveness/performance to begin to identify where C4ISR investments can be made to improve mission performance in the areas of CT/WMD, specifically in the area of first response. The following table describes what MOPs/MOEs the sub-panel will use and how they will be measured.

Issue	MOE	MOE Description	How MOE will be evaluated
	(list one or more MOEs to address each issue)	(provide a definition of each MOE)	(Describe the method to measure or calculate each MOE)
Containment of area	% area affected	How large of an area was contaminated by the CT/WMD attack	Using C4ISR systems (MASINT), determine how much area has been contaminated by the CT/WMD attack Could use Master Timeline Curves Model to pre-determine area
	# of fatalities	How many people have died and/or will die from CT/WMD event	

4.3.6 Schedule

The sub-panel will identify the schedule with milestones of how this study will be conducted and report back to the oversight group.

4.4 Objective 4: Determine the impact of C4ISR on long-term recovery efforts

Essential Elements of Analysis

1. What information is required to support long-term recovery from a CT/WMD event?
 - Where did the attack take place?
 - What is the extent of the damage?
 - Did the first responders contain the area?
 - What is the current status of the target area?
 - What is the environmental impact? How often should this be assessed?
 - What type of weapon was used? What are the secondary and third-order effects of this weapon/agent?
 - What information is being disseminated to the public? How?
 - Where are the displaced civilians? When should they return?
2. How is the current C4ISR architecture used to collect, disseminate, etc that information?
3. What are the quantity, quality, and timeliness requirements of that information? Does the current architecture satisfy requirements?

4.4.1 Methodology

The Remediation/Reconstitution sub-panel will begin to address the essential elements of analysis and their sub-questions by developing the influence diagrams to the post-event and recovery phase of the process (Figure 3),- meaning what data and information inputs influence the outcome or ability to understand that portion of the process. Then the sub-panel will identify which organizations can provide the data required to fully understand the process.

4.4.2 Scenarios

To fully analyze this objective, the study-working group will select a scenario or a variety of scenarios for use by the sub-panel to facilitate analysis. Both foreign and domestic situations should be addressed, that include each chemical, biological, nuclear, radiological, conventional high explosives, and industrial chemical capability. Scenario data will be obtained from each of the contributing agencies e.g. DTRA, CINCs, and FEMA.

4.4.3 Tools/Wargames/Models/Live Exercises

The best approach to analyzing this particular objective may be to use modeling and simulation techniques of proposed architectures and what the information demands may be over a long-term event. By assessing the C2 structure, one can identify how much information needs to be disseminated, thus determining how big the "pipes" need to be. One can also look at what are the future architectures and how they may resolve any information bottle-gaps given a current situation. In addition, M&S can be used to identify where alternative dissemination capabilities should or must be used. This analysis will begin to address where investments should be made to improve mission effectiveness of the long-term recovery from the use of CT/WMD.

The sub-panel will employ the following models and simulations to conduct quantitative analysis of the C4ISR architecture:

<i>Model/Simulation</i>	<i>Application</i>
Model #1	(Describe how the model will be used in the study, i.e. what issues will be addressed)
Model #2	
(etc)	

4.4.4 Data Sources

The sub-panel will identify the best data source/information source to assess each task in the area of mitigation and remediation/recovery. Each task should map back to the overall process as described in Figure 3.

4.4.5 Measures

The sub-panel will identify the measures of effectiveness/performance to begin to identify where C4ISR investments can be made to improve mission performance in the areas of CT/WMD, specifically in the area of mitigation and remediation/recovery. The following table describes what MOPs/MOEs the sub-panel will use and how they will be measured.

Issue	MOE	MOE Description	How MOE will be evaluated
	(list one or more MOEs to address each issue)	(provide a definition of each MOE)	(Describe the method to measure or calculate each MOE)

4.4.6 Schedule

The sub-panel will identify the schedule with milestones of how this study will be conducted and report back to the oversight group.

5. Study Products

- 5.1. The study working group will produce a written report that consolidates the observations, conclusions, recommendations and specific actions to implement those recommendations. Each sub-panel will draft the section based on the results of their particular focus. Each section will document the analysis process followed and any tools and data used.